Some Correction of Current Views on Cancer Location in Various Parts of the Stomach

According to the modern concept, the main sites of cancer localization in the stomach are believed to be its distal part, the posterior wall, and the lesser curvature. However, a large proportion of tumors originate on the greater curvature and the anterior wall of the stomach wall [28, 29, 33, 129]. This fact has not been given wide recognition owing to the old belief that these parts of the stomach are rare sites of primary cancer lesions. Therefore, we think it necessary to propose amendments to the existing structure of radiological examination of the stomach affected by tumor, based on our own experience. Our concept of the localization of gastric cancer is supported by A. Marzcell et al. (1989) and V. Eckardt et al. (1990), who point to the increasing incidence of carcinomas localized primarily on the anterior wall and the greater curvature of the stomach. P. Percivale et al. (1989) and J. Breaux et al. (1990) reported that cancer of the greater curvature occurs in 12.9% and cancer of the anterior wall in 8–10% of cases [99, 117]. This should stimulate a revision of the existing semiotic and methodological concepts in the diagnosis of gastric cancer. The orientation must be the search for endophytic tumors, particularly in the upper part of the stomach, where infiltrative cancer is especially frequent [31, 33, 35, 39]. Thus, we want to describe some signs of cancer in its early stages in those parts of the stomach which are unduly neglected by the modern cancer investigation protocols.

Cancer of the Cardiac Part

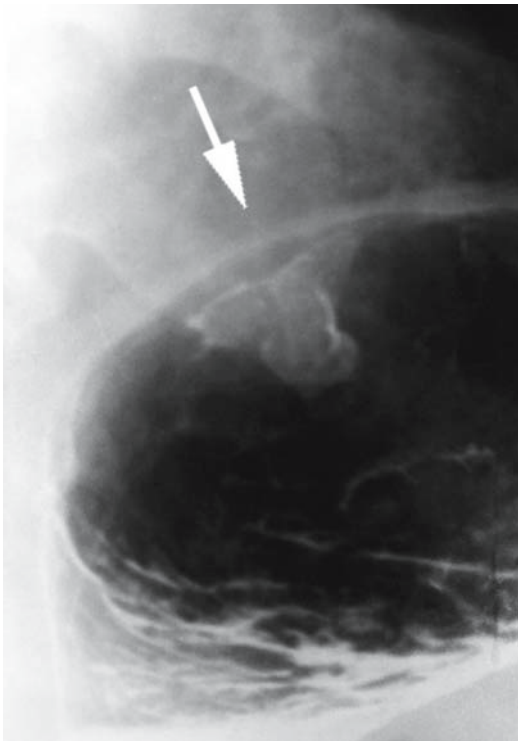
The diagnosis of tumors of the cardiac part of the stomach is associated primarily with the anatomical properties of this region. These include: pronounced relief, permanently changing zone of the functioning cardia, and the specific distribution of muscle fibers in this part of the stomach wall. Compression and palpation are impossible here.

It is necessary to note that the traditional method of detecting tumors of the upper part of the stom-

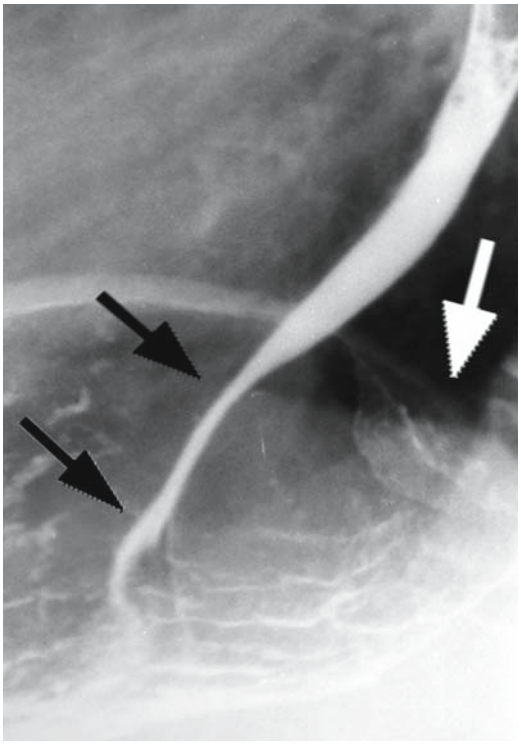
ach does not meet the requirements of modern gastro-oncology. The opinion is still held that dysphagia is the most specific symptom of cancer of the upper part of the stomach. Meanwhile, practical experience shows that this symptom appears, as a rule, at those stages of the disease when radical surgery is already impracticable or has little effect (◘ Fig. 118) [9, 18, 155].

In order to increase the efficacy of practical radiology in revealing cancer of the upper part of the stomach, it seems reasonable to divide this type of cancer into five groups according to the type of tumor:

1. Tumors of the cardia. Depending on the initial localization, this group should be subdivided into the following:
   a. Cancer of the cardia proper
   b. Supracardiac cancer
   c. Subcardiac cancer
   d. Precardiac cancer
   e. Retrocardiac cancer
2. Tumors of the anterior wall of the upper part of the stomach
3. Tumors of the posterior wall of the upper part of the stomach
4. Tumors of the stomach fundus
5. Tumors of the greater curvature of the upper part of the stomach

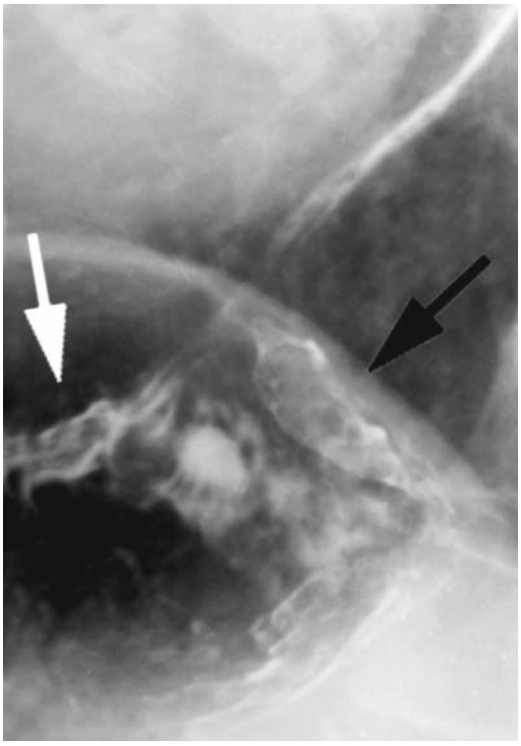


▲ **Fig. 118 a.**

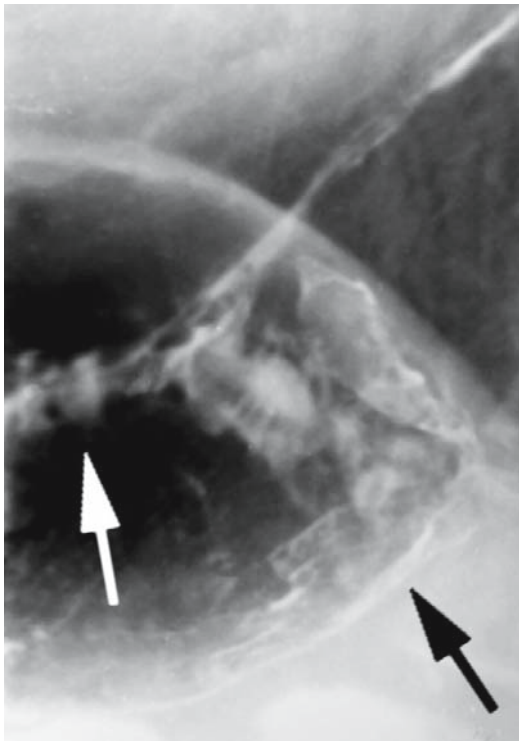


▼ **Fig. 118 b.**

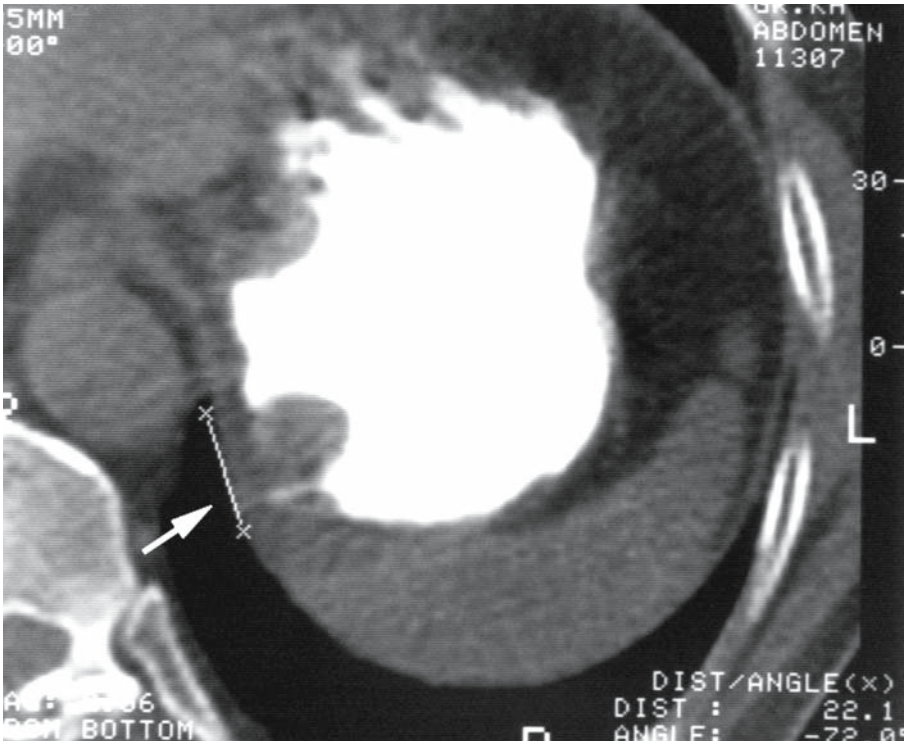
◘ **Fig. 118 a–f.** Female patient E., age 67. Diagnosis: gastric cancer. **a** Roentgenogram of the upper part of the stomach (double contrast, vertical position, anterior projection): wall of the fundus is thickened due to intramural infiltration (arrow). **b** Roentgenogram of the upper part of the stomach (double contrast, vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: the abdominal segment of the esophagus is unevenly narrowed (black arrows) due to spreading infiltration (white arrow). **c** Roentgenograms of the upper part of the stomach (double contrast, horizontal position, left posterior oblique projection): more distinctly visualized is thickening of the fundus walls due to intramural infiltration (black arrows); atypical relief of the cardiac rosette (white arrows). Conclusion: Infiltrative cancer of the upper part of the stomach with invasion of the esophagus. In order to estimate spread of infiltration onto the neighboring organs and tissues, the patient was examined by computed tomography. **d, e, f** Computed tomograms (tight filling with E-Z-CAT DRY, supine position): the wall of the fundus is thickened due to intramural infiltration spreading to the left crus of the diaphragm and the spleen (arrows). Endoscopic examination proved to be infeasible due to markedly narrowed esophagus.



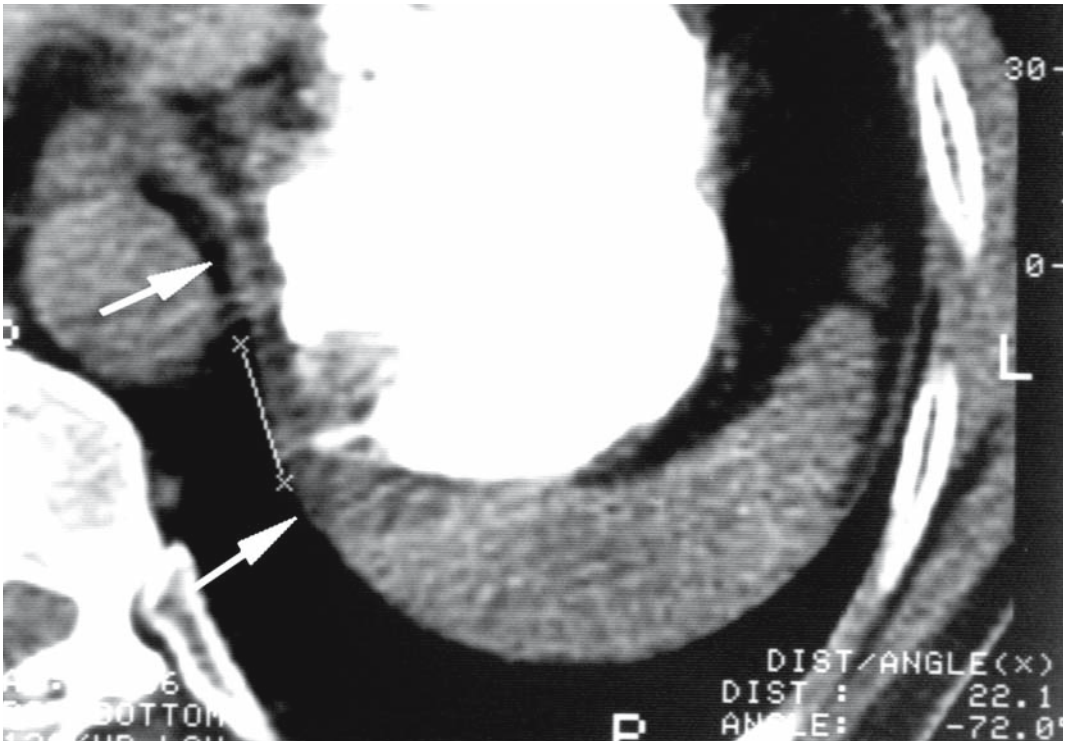
▲ Fig. 118 c.



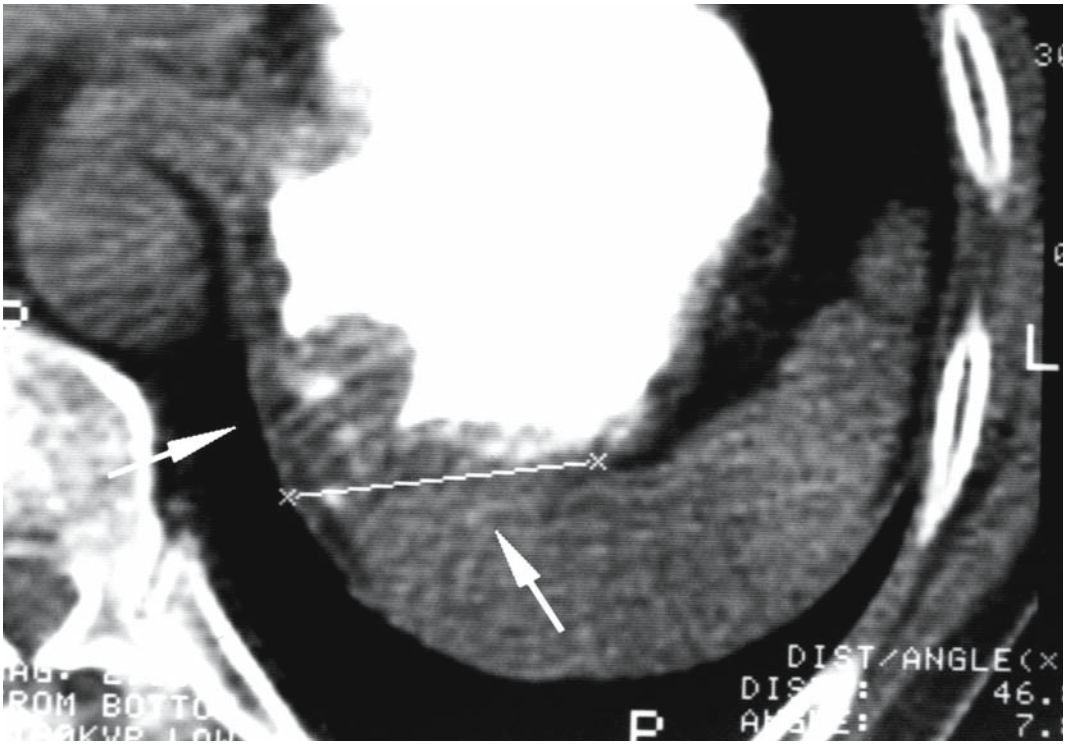
▲ Fig. 118 c.



◀ Fig. 118 d.



▲ **Fig. 118 e.**



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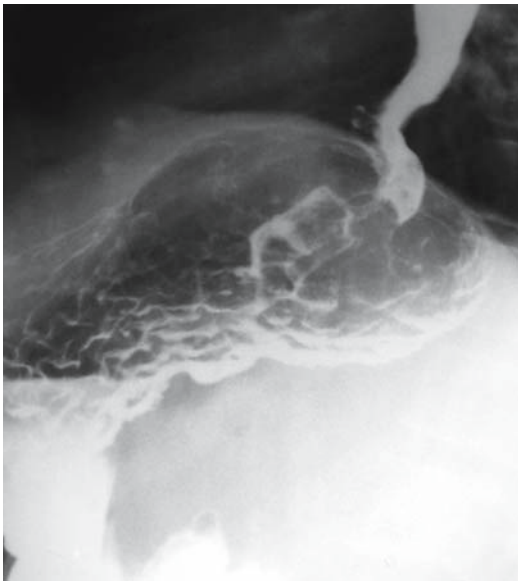

▲ Fig. 119 a.

▼ Fig. 119 b.

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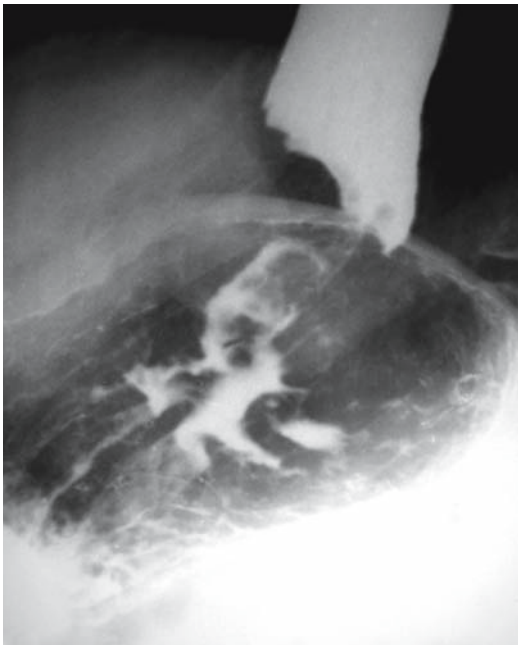
▼ Fig. 120 a.



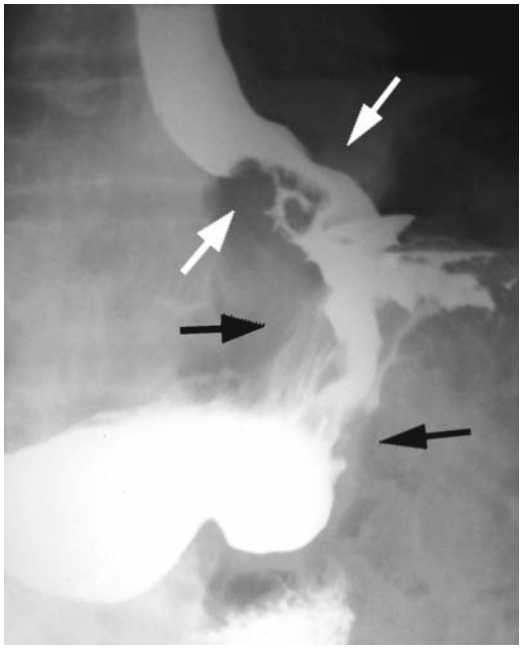
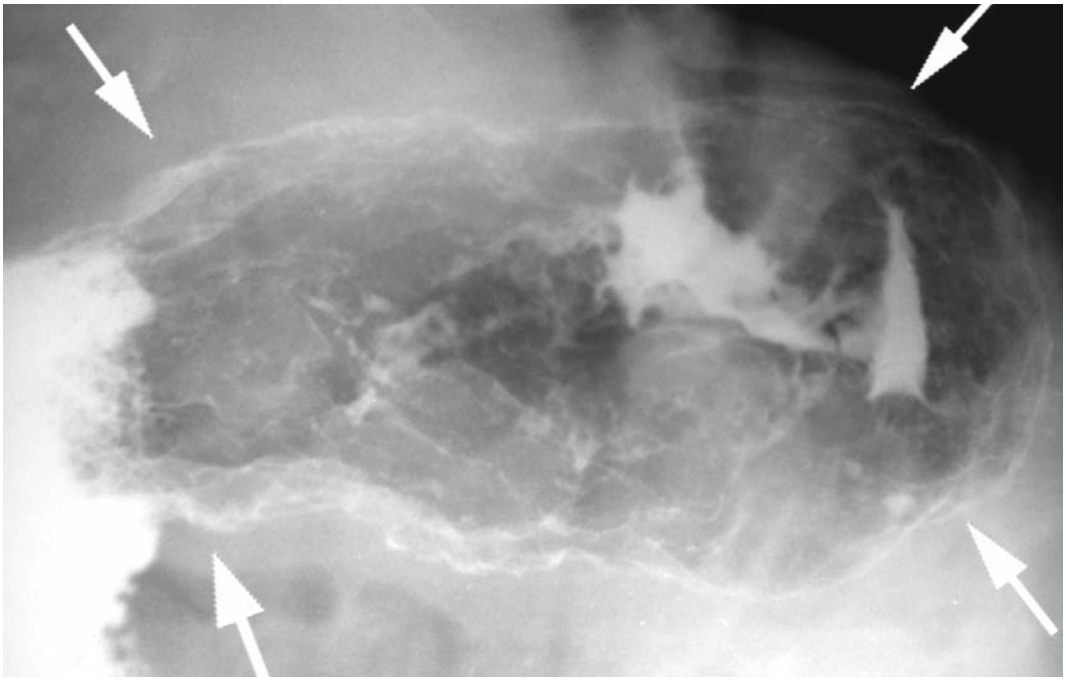
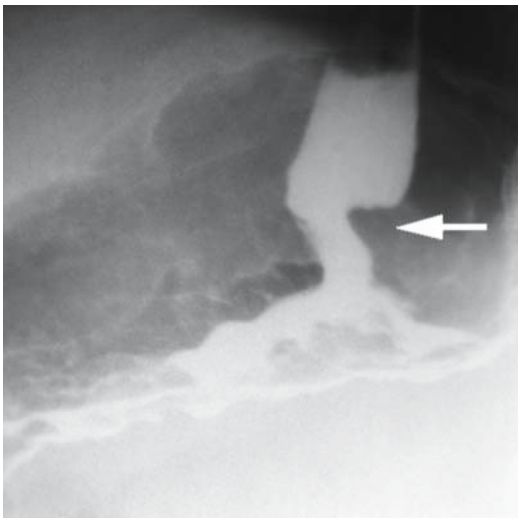


Fig. 119 a–c. Patient D., age 58. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: the abdominal segment of the esophagus is unevenly narrowed, its contours are uneven and eroded, the walls are rigid. **b** Roentgenogram of the upper part of the stomach (double contrast, horizontal position, left posterior oblique projection) at the moment of contrast medium passage through the gastroesophageal junction: mucosal folds terminate near the cardia; the contours of the abdominal segment of the esophagus are uneven and eroded. **c** Roentgenogram of the upper part of the stomach (double contrast, horizontal position, left posterior oblique projection): atypical relief of the cardiac rosette (cardioesophageal junction); termination of mucosal folds is distinctly visualized. Conclusion: Infiltrative cancer of the upper part of the stomach with invasion of the esophagus. Histologically, signet-ring cell carcinoma.

Fig. 120 a–e. Patient I., age 62. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection) at the moment of contrast medium passage through the gastroesophageal junction: uneven narrowing of the abdominal segment of the esophagus (white arrows), uneven and eroded contours of the body and the upper part of the stomach (black arrows). **b** Stomach roentgenogram (double contrast, horizontal position, left lateral projection): atypical relief of the cardiac rosette (cardioesophageal junction), the walls are rigid and thickened due to diffuse circular intramural infiltration (arrows). **c, d** Roentgenograms of the upper part of the stomach (double contrast, horizontal position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: uneven narrowing of the abdominal segment of the esophagus, uneven contours (arrow). Conclusion: Infiltrative cancer of the upper part of the stomach with invasion of the abdominal segment of the esophagus. **e** Endophotograph: the cardiac part is greatly narrowed due to spread of tumor which embraces the stomach walls circularly. Histological examination of the bioptates verified signet-ring cell carcinoma.



▲ Fig. 120 b.



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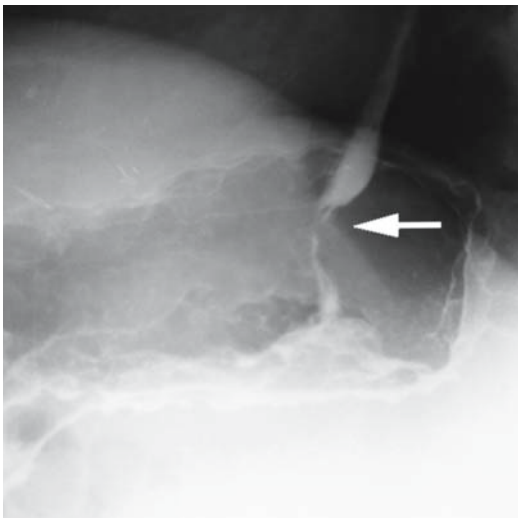

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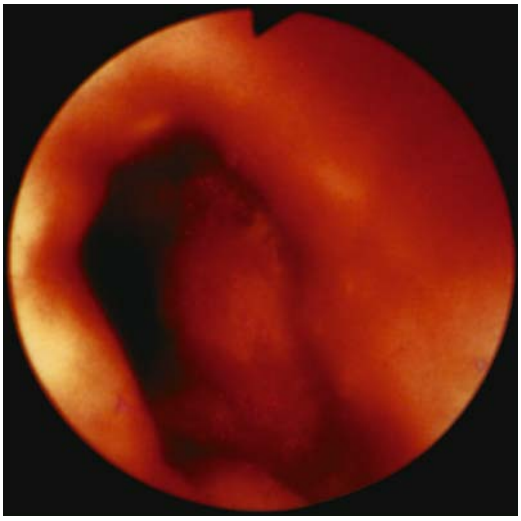


▲ **Fig. 120 e.**

Localization of the tumor within the boundaries of a given part of the stomach is the basic factor influencing the onset, the character, and terms of development of clinical symptoms. Thus, a tumor originating in the immediate vicinity of the cardiac sphincter relatively soon invades the abdominal segment of the esophagus to cause dysphagia (◘ Fig. 119). With a tumor located at a distance from the cardia, e.g., on the posterior wall or the greater curvature, this symptom occurs much later or not at all (◘ Fig. 120). But the initial site of the tumor does not determine the development of this or that clinical symptom exclusively. It also has a significant effect on the formation of radiological signs. Every experienced radiologist knows that there is a great difference between the traditional X-ray picture of cancer of the cardia and that presented by cancer of the posterior wall of the upper part of the stomach and the stomach fundus (◘ Figs. 121 and 122). Secondary changes characterizing further progress of the tumor differ as well. In some cases, these are invasion of the esophagus, in others the diaphragm, and in still others the splenic hilus, the pancreas, etc. [63, 82, 147, 151].

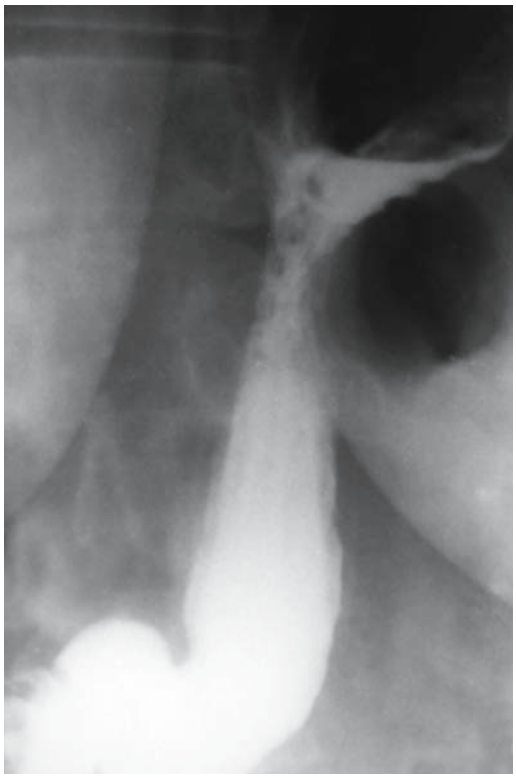
Thus, tumors originating in various locations of the upper part of the stomach can differ in at least three aspects:

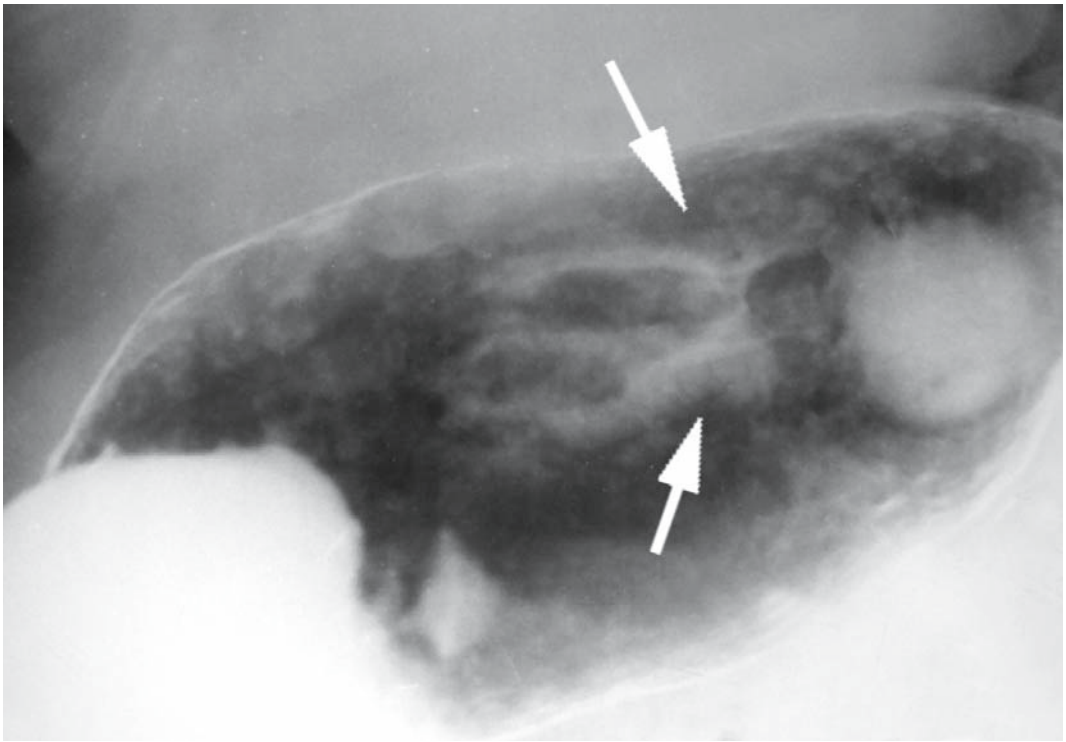
1. Clinical symptoms
2. Signs of blastomatous affection detectable by radiological methods
3. Complications associated with further growth of the tumor

Our experience and the data in the literature show that the traditional X-ray examination, based on the classical method of the first gulp and examination of the mucous membrane relief against the background of the air bubble, can diagnose proximal gastric cancer in 75–92% of cases [31, 38, 42, 52]. But these are generally advanced forms of cancer, in which diagnosis does not lead to cure. Although there are publications regarding early cancer of this part of the stomach, diagnosis of this tumor remains very complicated, and in some cases infeasible.

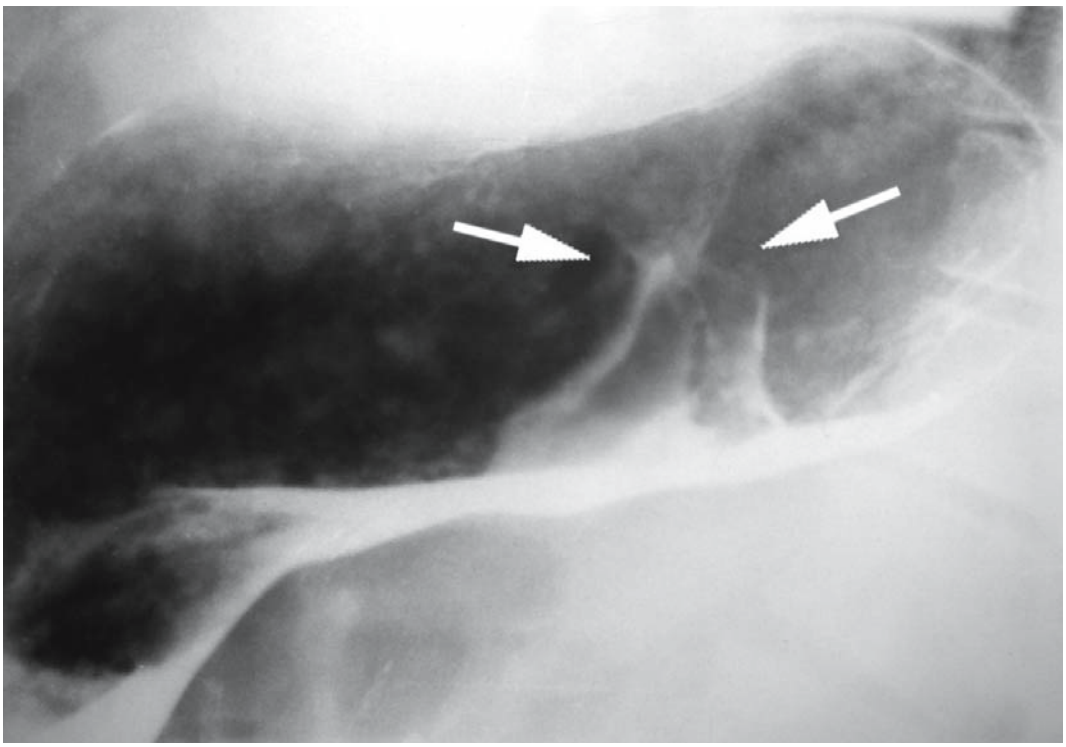
◘ **Fig. 121 a–c.** Female patient B., age 69. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): organic changes are not detectable. **b** Stomach roentgenogram (double contrast, vertical position, left lateral projection): the specific radiating pattern of the cardiac rosette is absent (arrows). **c** Stomach roentgenogram (double contrast, vertical position, left lateral projection): atypical relief of the cardiac rosette (arrows). Conclusion: Infiltrative cancer of the cardiac part of the stomach. The patient was operated. Histologically, signet-ring cell carcinoma.

▼ **Fig. 121 a.**

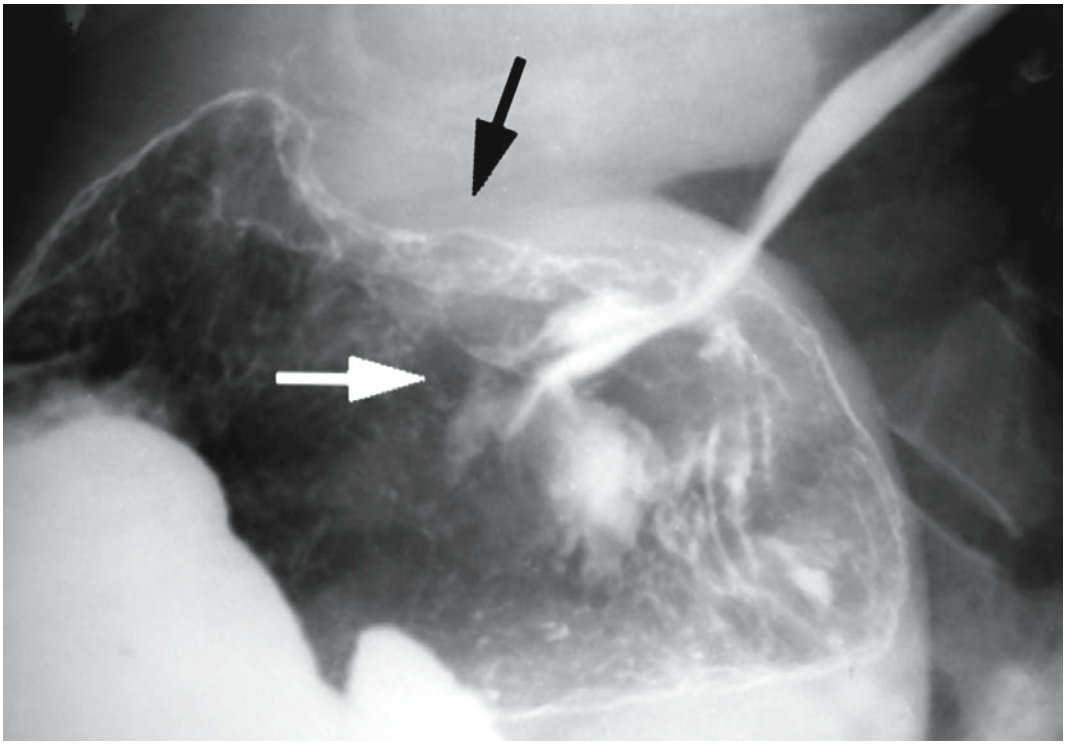




▲ **Fig. 121 b.**



▼ **Fig. 121 c.**



▲ Fig. 122 a.

▼ Fig. 122 b.

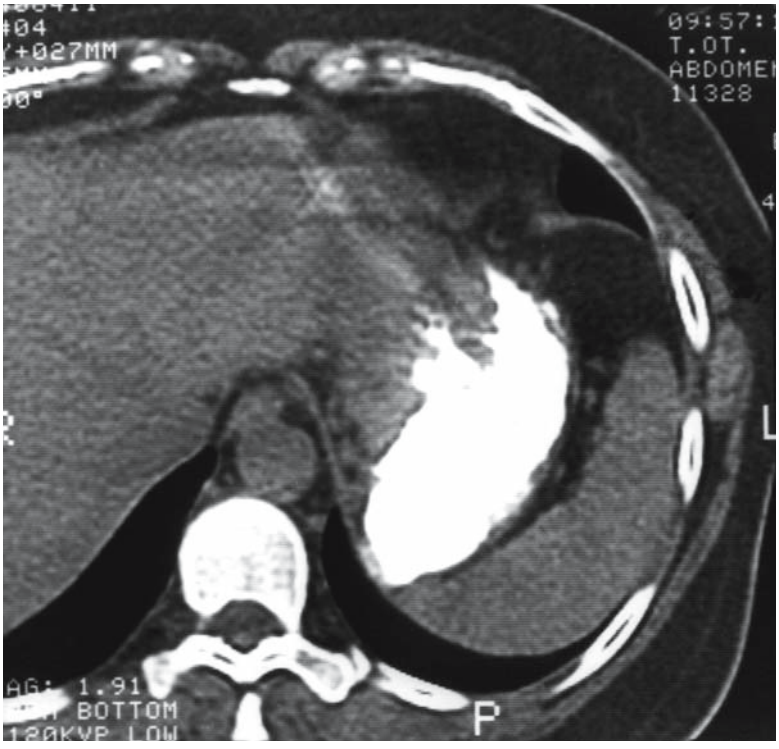
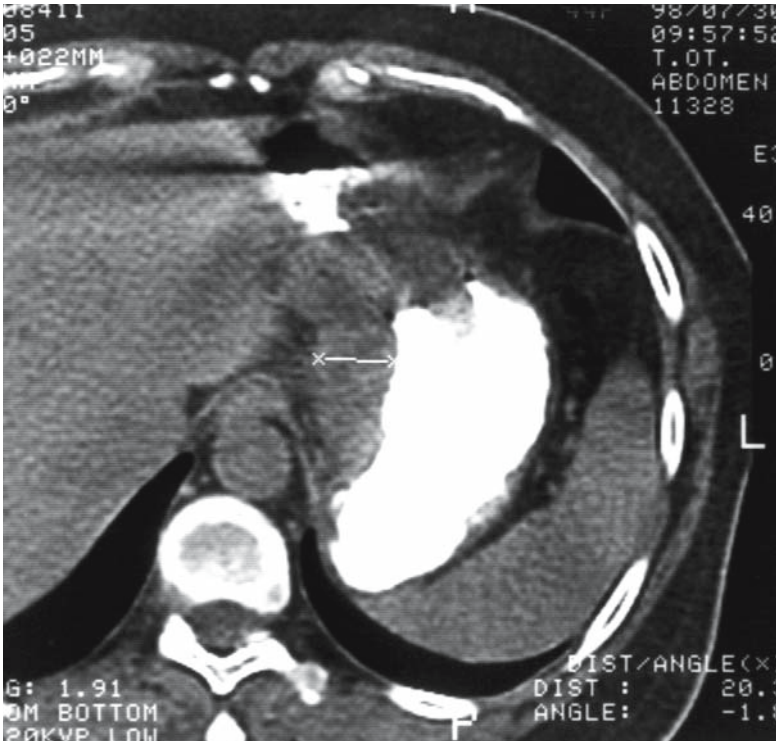
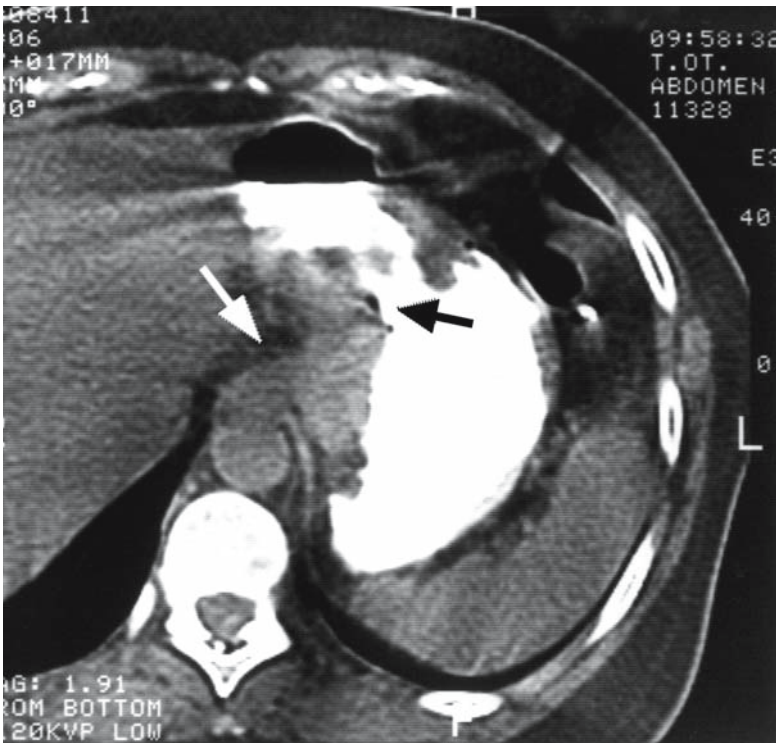


Fig. 122 a–g. Female patient K., age 55. Diagnosis: gastric cancer. **a** Stomach roentgenogram (double contrast, horizontal position, left lateral projection): the upper part of the stomach is disfigured, the anterior wall is thickened and rigid due to intramural infiltration (black arrow), atypical relief of the cardiac rosette (white arrow), the esophagus patency unimpaired. In order to verify the spread of infiltration onto the esophagus, the patient was examined by computed tomography. **b, c** Computed tomograms of the stomach (tight filling with E-Z-CAT DRY, supine position, the level of the stomach fundus): walls are thickened due to intramural infiltration. **d, e** Computed tomograms of the stomach (tight filling with E-Z-CAT DRY, supine position, the level of the cardiac and subcardiac parts): infiltration spreads to the abdominal segment of

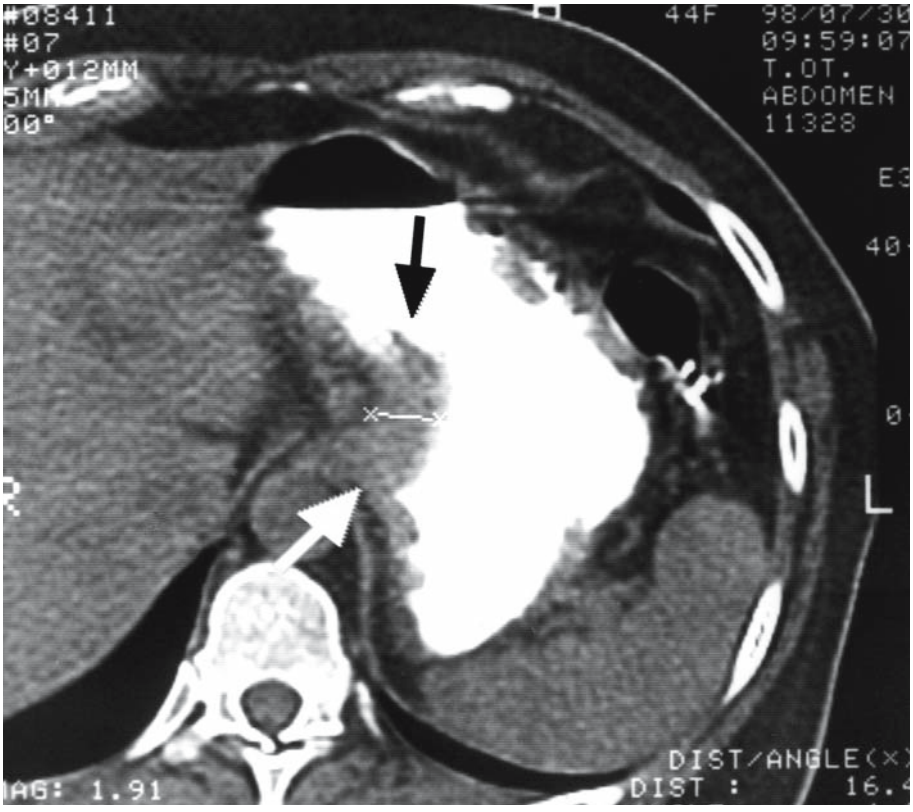


the esophagus (white arrow), the exophytic tumor component is visualized (black arrow). Conclusion: Cancer of upper part of the stomach with invasion of the esophagus, mixed type of growth. **f** Macrospecimen of a resected stomach: the exophytic component in the upper part (arrows) with the changed surrounding relief; infiltration spreads to the esophagus. **g** Fragment of the macrospecimen (strip): stomach wall is thickened due to intramural infiltration component of white color (arrows). Histologically, adenocarcinoma with the signet-ring cell component.

◀ **Fig. 122 c.**

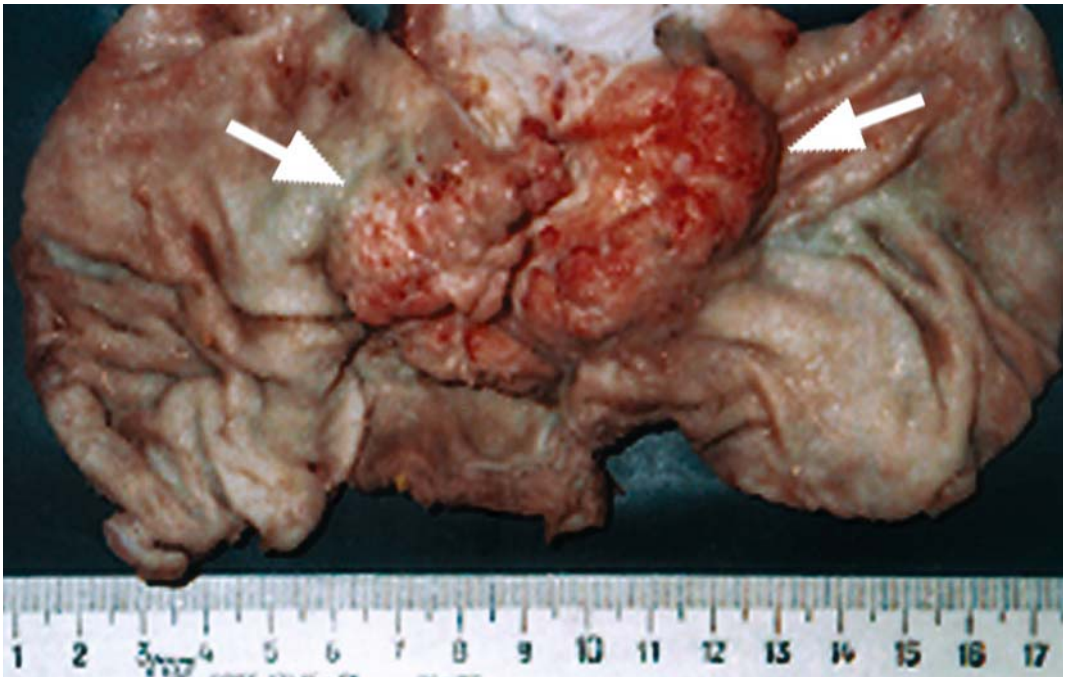


◀ **Fig. 122 d.**



◀ Fig. 122 e.

▼ Fig. 122 f.

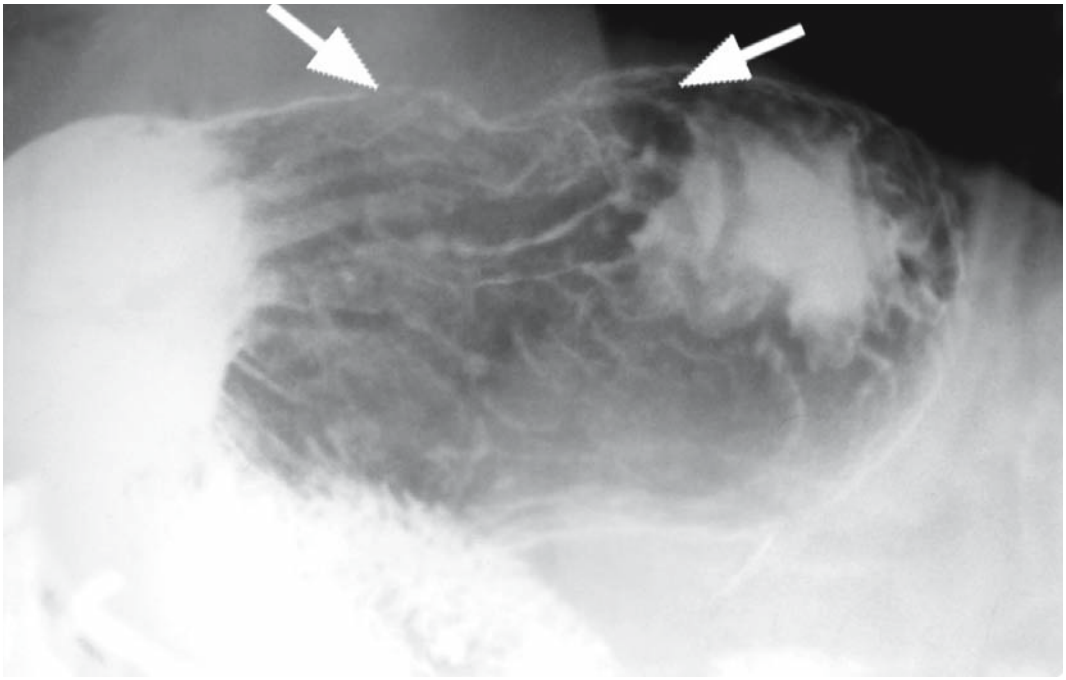


▲ **Fig. 122 g.**

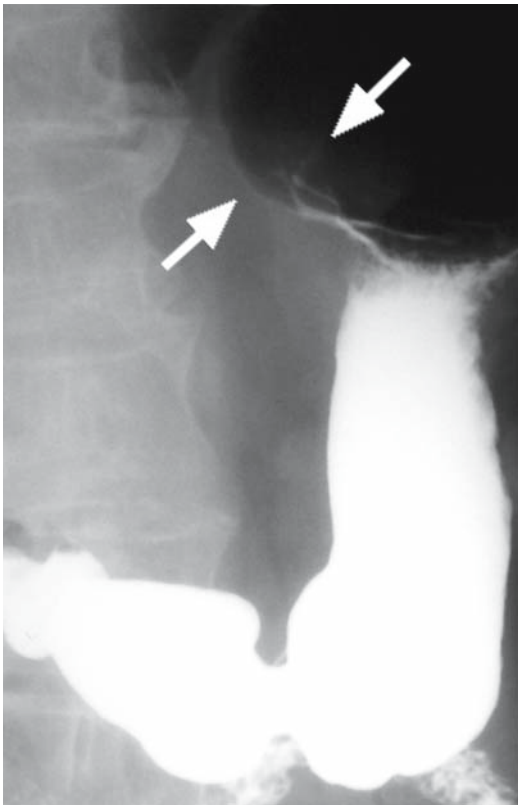
▼ **Fig. 123 a.**

Fig. 123 a, b. Patient S., age 38. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): organic changes are not detected. **b** Stomach roentgenogram (double contrast, horizontal position, left posterior oblique projection): stomach contour depressed on the anterior wall of upper part of the stomach, the wall at this level is rigid, the folds terminate near the infiltration (arrows). Conclusion: Infiltrative cancer of the anterior wall of the upper part of the stomach. The patient was operated. Histologically, nondifferentiated cancer.

Fig. 124 a–e. Female patient A., age 70. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): walls of the subcardiac part are thickened due to intramural infiltration (arrows). **b** Roentgenogram of the stomach and the lower third of the esophagus (tight filling, vertical position, anterior projection) at the moment of contrast medium passage through the gastroesophageal junction: uneven narrowing of the abdominal segment of the esophagus, its contours are uneven (arrow). **c, d** Stomach roentgenograms (double contrast, horizontal position, left lateral projection): atypical relief of the cardiac rosette (white arrows), anterior wall is thickened due to intramural infiltration (black arrows). **e** Roentgenogram of the stomach and the lower third of the esophagus (double contrast, horizontal position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: abdominal segment of the esophagus is unevenly narrowed, its contour uneven and eroded (arrow). Conclusion: Infiltrative cancer of the upper part of the stomach with invasion of the esophagus. The patient was operated. Histologically, adenocarcinoma with the signet-ring cell component.



▲ Fig. 123 b.



▼ Fig. 124 a.

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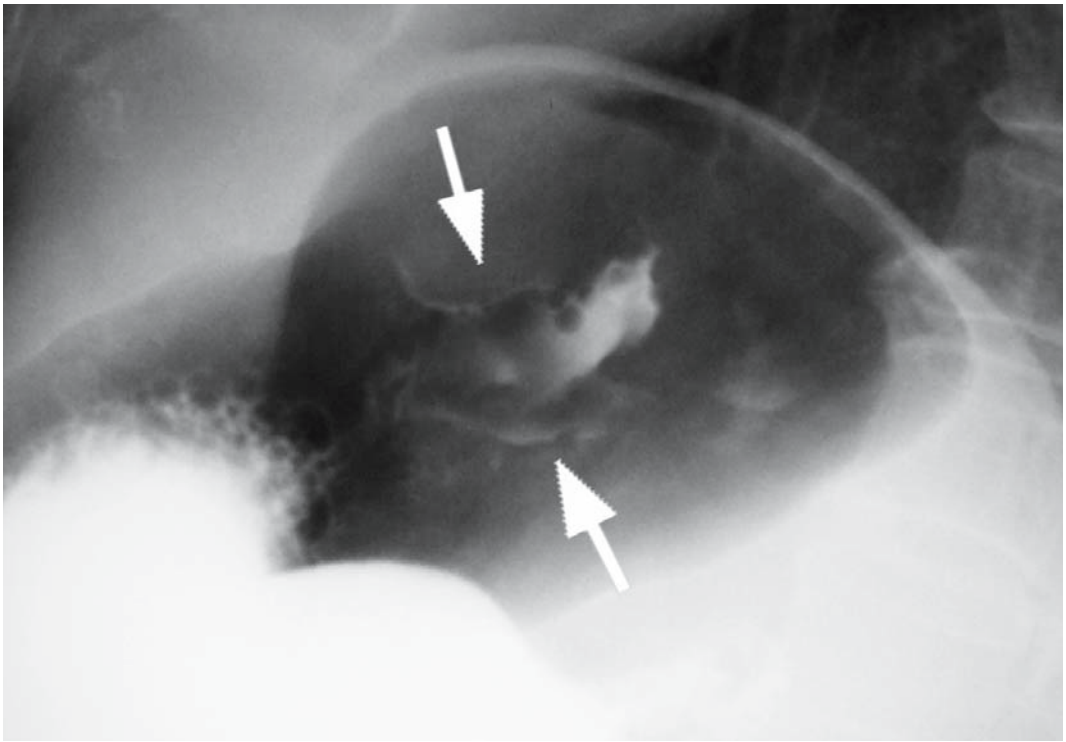
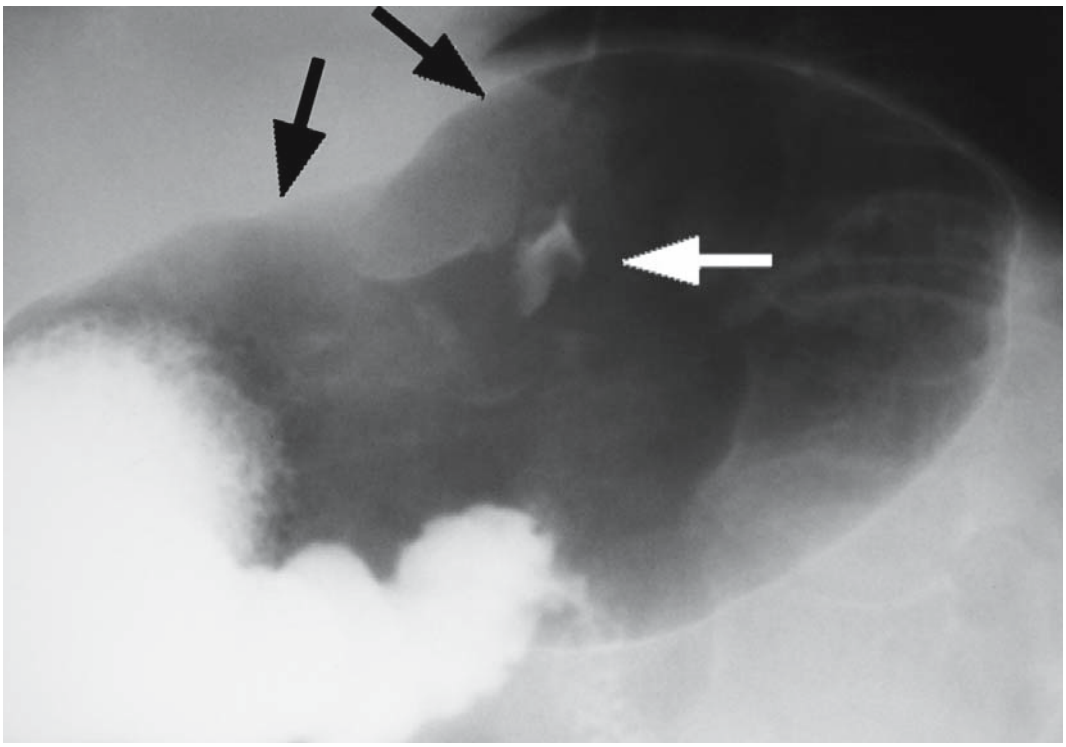
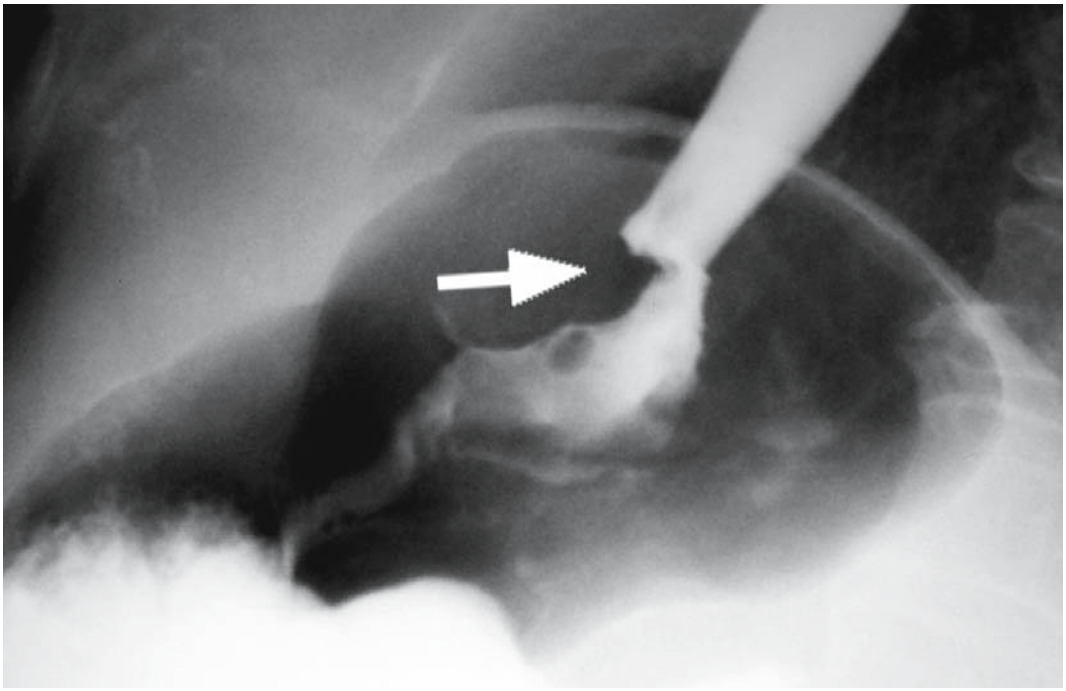


▲ **Fig. 124 c.**



▼ **Fig. 124 d.**



▲ **Fig. 124 e.**

M. Mori, Y. Adachi, and K. Nakamura et al. (1987) report that early cancers of the upper part of the stomach account for only 1% among similar tumors in other localizations (◘ Fig. 123). Sometimes, proximal cancer is diagnosed in cases where more than two walls of the upper part of the stomach are involved e.g., posterior wall and cardia; fundus and cardia; greater curvature and cardia; anterior wall and cardia (◘ Fig. 124). Affection of only one wall is revealed in comparatively rare cases, this usually being the anterior wall of the upper part of the stomach. The reasons for this disappointing result are found in the absence of clinical signs in the early stages of the process and in the complicated anatomical structure of this region, the visualization of which requires special approaches. The main problem is the presence of the so-called blind zones for both traditional X-ray examination and endoscopy. In other words, cancer of the upper part of the stomach may run an asymptomatic course for a long time. Known clinical, radiological and endoscopic signs are sometimes insufficient to establish the diagnosis of cancer at the stage when adequate treatment may cure the patient.

Another specific feature is the anatomic-functional formation known as the cardioesophageal rosette (junction). Its normal functional and anatomical structure is characterized by the convergence of esophageal folds straight into the cardiac folds. For this reason, owing to the only slightly marked submucous coat of the interfold space, the folds remain impregnated with barium sulfate suspension in adequately performed double-contrast radiology. Their imaging differs depending on individual variations, as was described in ▶ Chap. 5.

We meet with certain difficulties while conducting a differential diagnosis of the early signs of cancer of the cardia and rosette imaging. The difficulties are especially serious in the absence of sufficient clinical gastroesophageal symptoms. These difficulties are even more aggravated in endoscopic evaluation of the early manifestation of the tumor, again because of the close vicinity of the cardioesophageal junction and meager signs of tumor on the surface of the gastric mucosa. In such situations we are assisted by CT or MRI of the stomach. These methods give us additional information on the limited thickening of the wall, and at this level we are looking for

the signs characteristic of the initial changes in the esophagus. This, after all, helps us to verify the diagnosis (see ▶ Fig. 83). Unfortunately, in the absence of these techniques, we have to resort to dynamic observation of the patient using traditional roentgenology and endoscopy. Our experience shows that after several months, sometimes after a year, endoscopy and biopsy confirm our initial diagnosis, and the patient can undergo surgery. But in some cases, this turns out to be »normal« imaging of the cardioesophageal junction. On the one hand, such cases serve to confirm the need to abandon the existing concept that only histological verification is an indication for surgery. In the absence of information supplied by CT and MRI, which confirm pathology in such patients, we are guided by the dynamic observations. In the absence of signs of tumor for a sufficiently long time (up to a year), this picture may be regarded as an individual variant of the rosette structure (see ▶ Fig. 50b) [35, 47, 226].

With regard to the prognostic importance of radiological and endoscopic signs, it is necessary to point out that most of the signs described are characteristic of advanced tumors. The affected cardia, which the classical roentgenologists compared to a rigid tube, a thickened infiltrated fundus, an additional shadow of the tumor against the background of the air bubble – all indicate cancer at a far advanced stage and the futility of attempts to help the patient. The signs of tumor spreading to the esophagus have the same significance.

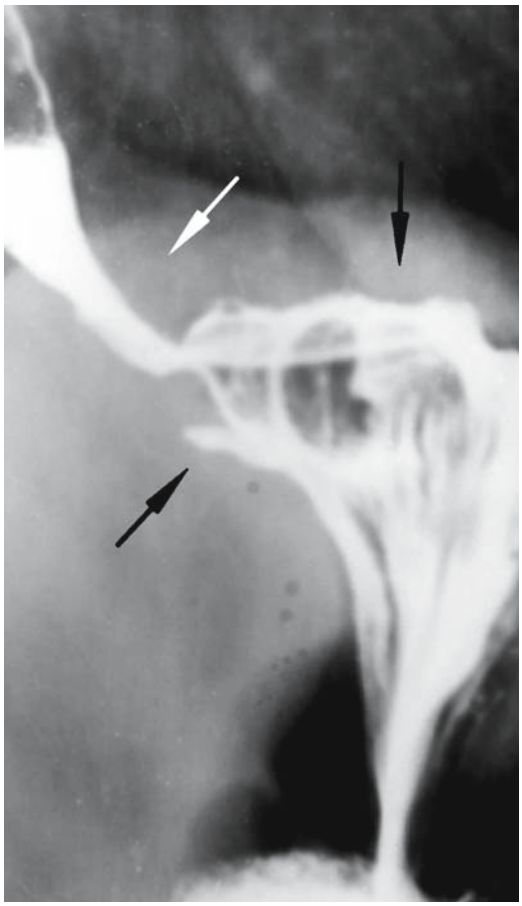
Here it is necessary to discuss some specific properties of the neoplastic process at this localization. Retrospective analysis of the available clinical and X-ray signs of cancer of the upper part of the stomach shows that this cancer grows for a relatively long time without causing such discomfort to the patient that he seeks medical aid. Despite the large size of the tumor, the clinical picture (unmotivated weakness, low capacity for work, poor appetite, gastric discomfort, unexplained loss of weight, depression) may be so inconspicuous that only long-standing symptoms may cause the patient to visit his doctor. Again, dysphagia must be regarded as a late clinical symptom resulting from the spread of tumor infiltration to the abdominal segment of the esophagus. Some authors state that early dysphagia may develop owing to the concurrent esophageal spasm, but we have always found infiltration of the esophagus in patients with dysphagia, using radiological examination of the esophagus and the stomach (traditional X-ray plus double contrast, CT, MRI) in combination with endoscopy and biopsy. We observed dysphagia developing at various stages of the disease. The extent of affection and the severity of changes in the lower third of the esophagus and the upper part of the stomach did not always agree with the time of onset and severity of dysphagia. We have observed cases of proximal cancer of the stomach and invasion of the esophagus in which it was very difficult to establish the primary affection of the stomach and impossible to visualize the cardia endoscopically. The first symptoms of dysphagia appeared at least 1–1.5 months before endoscopic examination revealed a typical picture of cancer. The reverse was also possible: Dysphagia was absent altogether in patients with a marked tumor infiltration of the walls of the upper part of the stomach, or the first symptoms of dysphagia were so insignificant that it was possible to establish its onset only from anamnestic data going back several months before the patient complained. This means that analysis of clinical symptoms can suggest the initial location of the tumor in a particular upper portion of the stomach prior to surgery and morphological study of the resected material: In the former case, we have the tumor of the cardia with rapid involvement of the esophagus, and in the latter the tumor originated at a relatively long distance from the cardiac rosette (see ▶ Figs. 51 and 87). On this aspect, we agree with S. Kholdin (1952) and W. Sweet (1976), who indicated that cancer of the lower parts of the esophagus was closely connected with blastomatous infiltration of the stomach wall. The prevalence of tumors in the lower third of the esophagus is actually due to overlooking cancer of the cardia; isolated affection of the abdominal and other lower segments of the esophagus is a very rare occurrence. In other words, discovery of blastomatous affection of the lower third of the esophagus must lead the radiological diagnostician and endoscopist to perform a thorough examination of the stomach despite the difficulties arising from severely impaired patency. In our opinion, the pressing task of current radiological diagnosis consists not in simply detecting the signs characteristic of affection of the cardioesophageal

junction and abdominal segment of the esophagus (»elongation« of the esophagus, splashing of the barium sulfate suspension, wall thickening, etc.); these signs may be specific but they have no positive prognostic potential. Rather, it consists in revealing signs of the presence of operable new growths, which might be a valuable supplement to endoscopic findings. Although endoscopy with lateral lenses is very effective, inspection of this part of the stomach remains difficult. The X-ray examination also meets with some insoluble problems. This points up how serious the problem is. It is especially difficult to reveal pathology in patients with so-called cascade stomach. This is often the result of cancer of the posterior wall of the upper third of the stomach body and the cardia, or of a tumor, the size of which does not exceed that of the cardiac zone. Detection of such new growths requires the entire available set of X-ray methods, including double contrast in addition to tight filling.

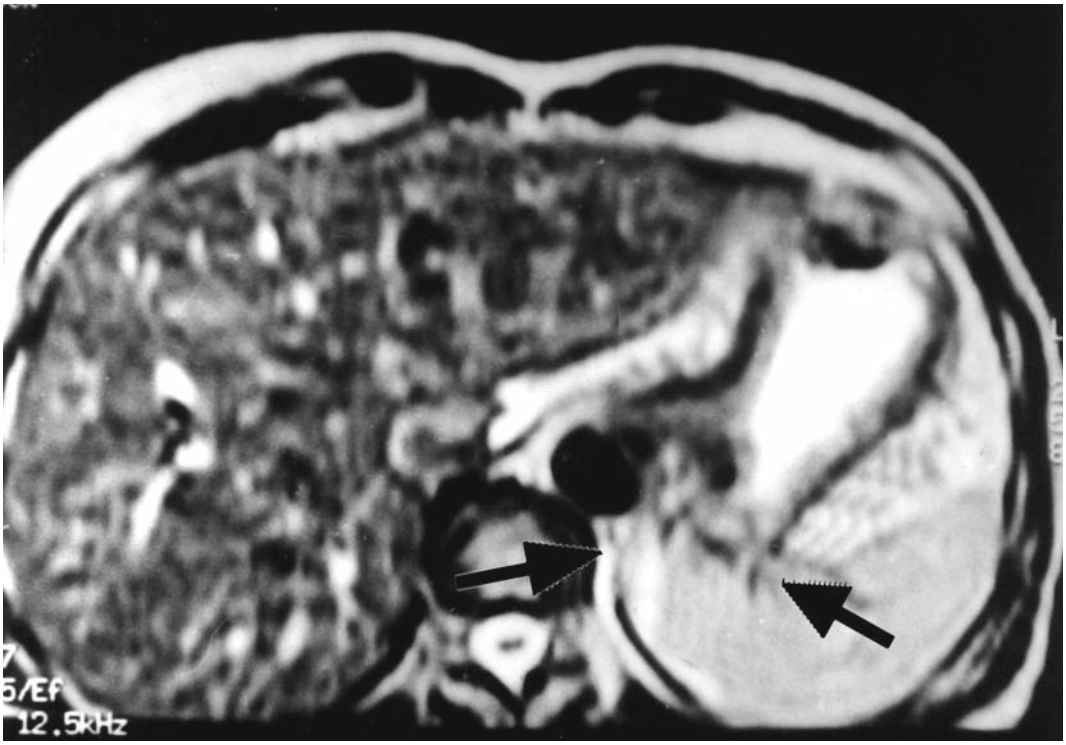
Concerning blastomatous affection of the upper part of the stomach, it is necessary to note the possible diagnostic use of the air bubble, which is always present in the stomach. We mean the so-called symptom of air redistribution or an elongated air bubble. Epstein and Wasch (1944) were the first to indicate that the changed shapes of the air bubble in the stomach might be used for diagnostic purposes. However, we do not think that this phenomenon can be regarded as pathognomonic for endophytic cancer of the stomach, because this also occurs during the cicatrization of large benign ulcers owing to the formation of fibrous tissue. Air can also be redistributed in the stomach under pressure exerted on it from various formations and space-occupying processes (enlarged left lobe of the liver, cyst, tumor extending from the neighboring organ, and the like). Despite the low specificity of this sign, its presence discovered during examination of the patient with gastric symptoms narrows down the range of pathologies which might be considered in the given case. The sign is simple. to detect. It is necessary only to examine the abdominal cavity attentively before the patient ingests barium sulfate suspension and to evaluate the suspected part of the stomach with orientation to the obligatory presence of the air bubble under the left arch of the diaphragm. In contrast to its normal position in the stomach fundus, the air bubble in such situations has a »tail« in the stomach body, and the amount of air is much greater than that in the normal air bubble.

Other signs of pathology of the upper parts of the stomach manifested by changes in the air bubble, which are of secondary importance as regards their prognostic value, are an additional shadow, which is characteristic of exophytic new growths, and also a significantly increased stomach–diaphragm distance due to tumor infiltration in the stomach fundus, which is not displaced during deep breathing due to its growth into the adjacent organs. The air redistribution sign is of greater importance than the described changes because it occurs in patients with relatively small and operable carcinomas.

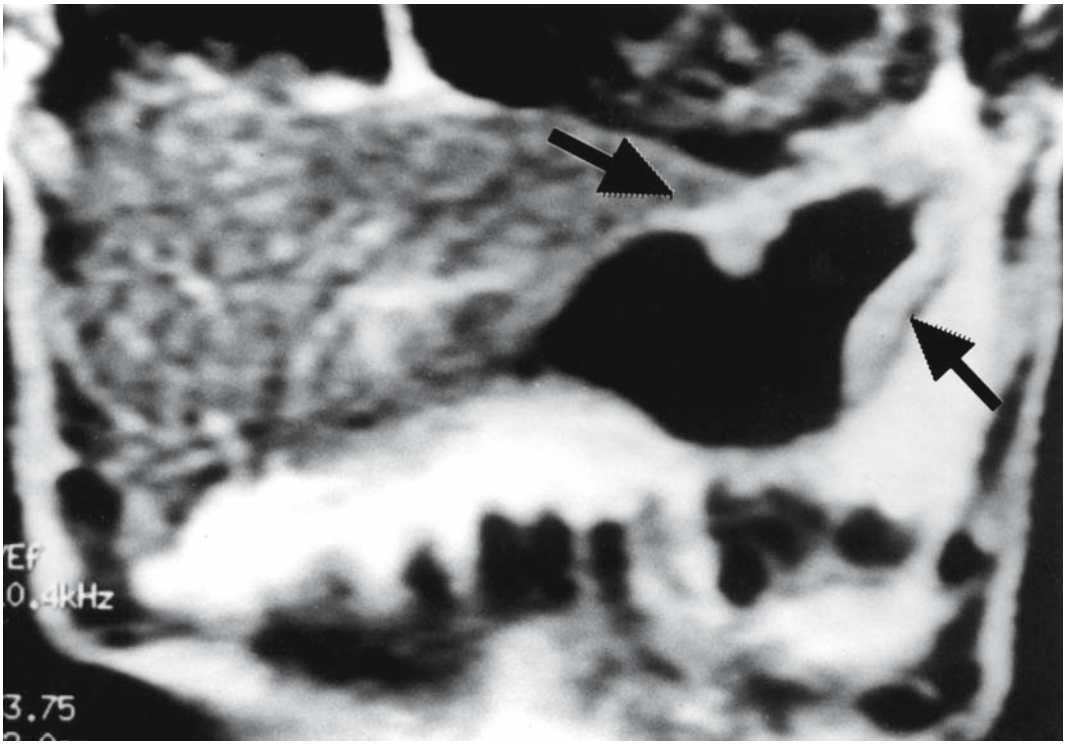
▼ **Fig. 128 a.**



▲ Fig. 128 b.



▼ Fig. 128 c.



▲ Fig. 128 d.

▼ Fig. 128 e.

Fig. 128 a–e. Female patient V., age 53. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): contour of the cardiac part and the fundus is uneven (black arrows), the abdominal segment of the esophagus is circularly narrowed, with a small suprastenotic dilatation (white arrow). **b** Stomach roentgenogram (double contrast, horizontal position, left posterior oblique projection): walls of the upper part are thickened and rigid due to intramural infiltration (arrows). Conclusion: Infiltrative cancer of the upper part of the stomach with invasion of the esophagus. In order to verify the infiltration spread, the patient was examined by MRI. **c** MRI (axial projection, level of upper part of the stomach, T2 image): walls of the fundus are thickened unevenly due to intramural infiltration. Infiltration spreads onto the abdominal segment of the esophagus with strongly narrowed lumen, and also onto the left crus of the diaphragm and the medial edge of the spleen (arrows). **d** MRI (coronary projection, level of upper part of the stomach, T2 image): uneven thickening of the fundus walls with infiltration spread to the upper two thirds of the stomach body (arrows). Conclusion: Infiltrative cancer of the body and the upper part of the stomach with invasion of the abdominal segment of the esophagus, the left crus of the diaphragm, and the medial edge of the spleen. **e** Fragment of a macrospecimen (strip): the wall of the stomach is thickened due to intramural infiltration of white color (arrows). Histologically, signet-ring cell carcinoma.

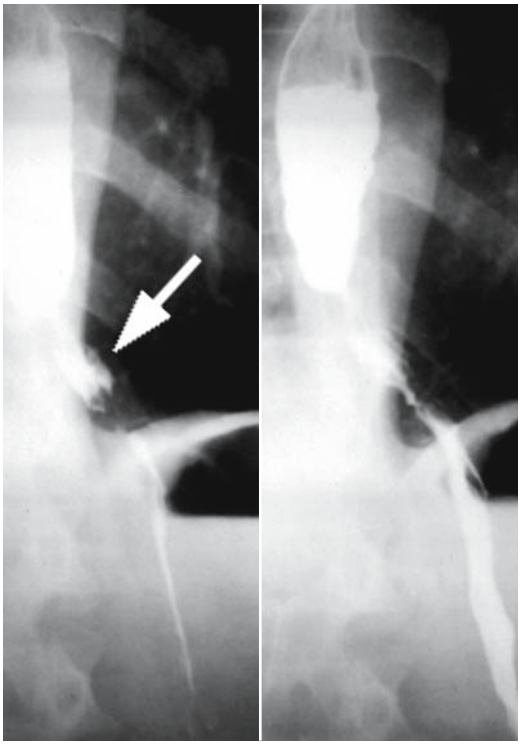
Fig. 129 a–c. Patient V., age 43. Diagnosis: cancer of the lower third of the esophagus with invasion of the cardiac part of the stomach. Complaints of dysphagia, vomiting after meals, which continued for 3 months. Weight loss, 10 kg. **a** Roentgenograms of lower third of the esophagus (tight filling, vertical position, anterior projection) at the moment of contrast medium passage through the gastroesophageal junction: the lower third of the esophagus is unevenly circularly narrowed; uneven contours. A depot of contrast medium in the supradiaphragmatic segment (arrow). **b** Roentgenogram of lower third of the esophagus (tight filling, vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: an ulcer niche with eroded contours on the anterior wall of the supradiaphragmatic segment of the esophagus (arrow), atypical relief of the cardioesophageal junction. **c** Roentgenogram of upper part of the stomach (double contrast, vertical position, anterior projection): thickened wall of the cardia due to tumor infiltration is seen against the background of the air bubble with the stretched folds of the proximal part of the stomach (arrow). Conclusion: Infiltrative cancer of the cardiac part of the stomach with involvement of the esophagus. Ulceration of the anterior wall of the supradiaphragmatic segment of the esophagus. The patient was operated. Histologically, squamous cell cancer. Such cases are relatively rare. As a rule, cancer occurs in the stomach with subsequent spread to the esophagus. Nevertheless, traditional X-ray examination with double contrast reveals affection of the cardiac part of the stomach. This is another confirmation of our point of view that radiological methods of examination should be used again in gastroenterology.

Double-contrast radiology has the greatest potential in the traditional X-ray examination of the upper parts of the stomach. Only this method can demonstrate wall thickening and loss of elasticity at the initial stages of the malignant process. Thick and rough folds add to the double-contrast imaging, and this suggests malignancy. At the same time, it should be noted in this connection that it is possible to study contours of the upper part of the stomach using some manipulations such as changing the patient's position from vertical to tilted, or from horizontal to vertical, which helps to estimate the condition of the walls in cascade stomach.

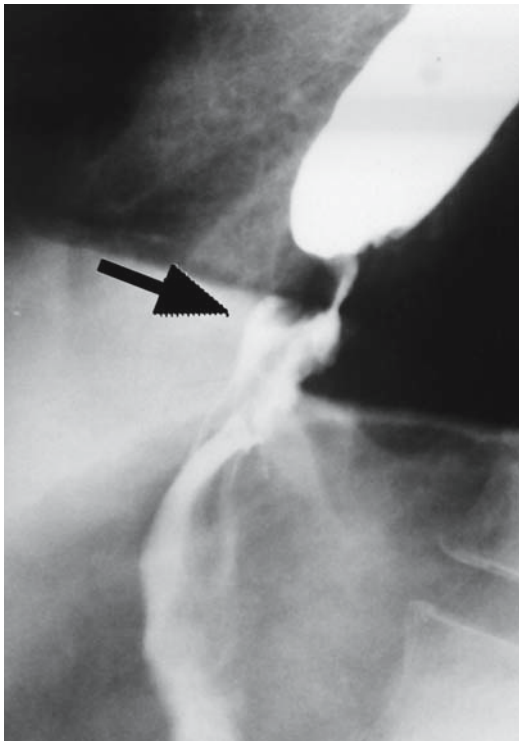
During recent decades, there has been a distinct tendency toward an increasing occurrence of tumors in the upper part of the stomach. This is the point of particular concern to specialists, because cardioesophageal cancer has the worst prognosis when compared with tumors of all other localizations (Fig. 128).

It has become commonplace that when discussing new growths in this localization we usually mean advanced cases. The main reason for oncological neglect is that the patients present late for medical attention, i.e., they do not visit the doctor until the dysphagia dominates the clinical picture, indicating the spread of the process onto the esophagus. The difficulty of diagnosing proximal cancer is due (in addition to the late clinical manifestations) to the fact that the prevalence of endophytic forms over exophytic forms is not taken into consideration. The radiological semiotics of cancer of the upper part of the stomach continues to be based on the old signs of exophytic new growth (additional shadow, splashing of barium sulfate suspension, etc.).

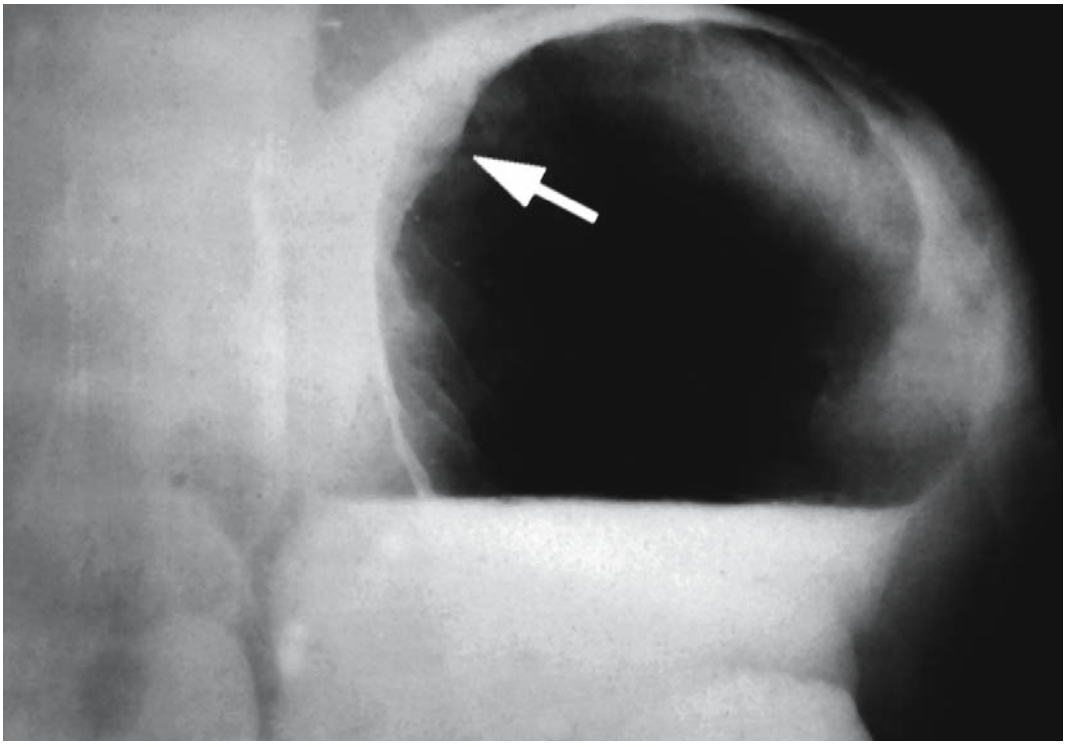
Another problem has become the subject of special concern for gastroenterologists in recent years. This is the so-called specialized columnar epithelium, or Barrett's esophagus (Barrett epithelium; the lower part of the esophagus is lined with cylindrical epithelium; gastrointestinal metaplasia). Barrett's esophagus is an acquired disease in which squamous epithelium of the esophagus is replaced by cylindrical epithelium, owing to the prolonged attack on the mucous membrane by gastric contents; it is regarded as a complication of gastroesophageal reflux alongside with ulcers and peptic strictures of the esophagus. The British surgeon



▲ Fig. 129 a.



▲ Fig. 129 b.



▼ Fig. 129 c.

N. Barrett was the first to describe the syndrome in 1950; it includes hernia of the esophageal hilus of the diaphragm, peptic ulcer of the esophagus, and focal changes in the mucous membrane of its distal part [93]. During recent years, the interest of gastroenterologists in Barrett's esophagus has increased significantly. This is explained by the epidemic spread of this pathology worldwide (beginning in the 1980s) and by the considerably increasing occurrence of proximal cancer of the stomach. Gastrointestinal metaplasia is regarded by the gastroenterological community as a precancerous condition, because the incidence of adenocarcinoma in such patients is 30 times higher than in the population as a whole.

Histological examination of columnar epithelium, which results from metaplasia and replaces multi-layered squamous epithelium, differentiates between the following three types of cells in accordance with Barrett's classification:

1. Fundal
2. Cardiac or transitional
3. Specialized intestinal

Columnar epithelium of the stomach is practically identical to epithelium of the fundus and the cardia, whereas the specialized cylindrical epithelium has the properties of gastric and intestinal epithelium: The cells have cilia on their surfaces and crypts containing mucus-forming goblet-shaped, and entero-endocrine cells. Combinations of various forms of metaplasia of the esophageal epithelium are also possible, but the absorbing capacity of these cells is insufficient, as distinct from true enterocytes. Therefore, intestinal-type metaplasia is regarded as incomplete. Esophageal metaplasia may extend to a distance of 3–15 cm from the line of transition of the gastric epithelium to the esophageal epithelium.

Endoscopically, the following two types of Barrett's esophagus are distinguished:

1. A short segment of the Barrett esophagus – metaplasia extends for less than 3 cm
2. A long segment of the Barrett esophagus – metaplasia extends for more than 3 cm

There are some factors predisposing to development of Barrett's esophagus. Thus, hernia of the esophageal hiatus of the diaphragm occurs in 75–80% cases, and dysfunction of the lower esophageal sphincter develops in 19–20% patients. There are no pathognomonic symptoms of Barrett's esophagus, and its clinical symptoms do not differ from those of the gastroesophageal reflux, but it should be noted that about 95% of patients experience heartburn.

At the present time, endoscopy with biopsy of the mucous membrane is commonly used for diagnostic purposes, but the endoscopic signs are sometimes meager and therefore, between four and 15 bioptates should be taken from various parts of the esophagus spaced at 1–2 cm. On esophagoscopy, the portion of cylindrical metaplasia appears hyperemic and contrasts with the pale pink epithelium of the esophagus.

Since patients with Barrett's esophagus are highly predisposed to adenocarcinoma, it is necessary to note again that roentgenology should be returned to the field of gastroenterology as soon as possible. The lower segments of the esophagus of patients with X-ray signs of reflux esophagitis will then be examined by the endoscopist more thoroughly. The necessary number of tissue specimens will be taken to facilitate the diagnosis of blastomatous processes at the earlier stages (Fig. 129).

Thus, from the current standpoints of epidemiology and morphology of gastric cancer, tumors of the upper part of the stomach have become the pressing problem of gastro-oncology in the twenty-first century.

Cancer of the Antral and Pyloric Parts

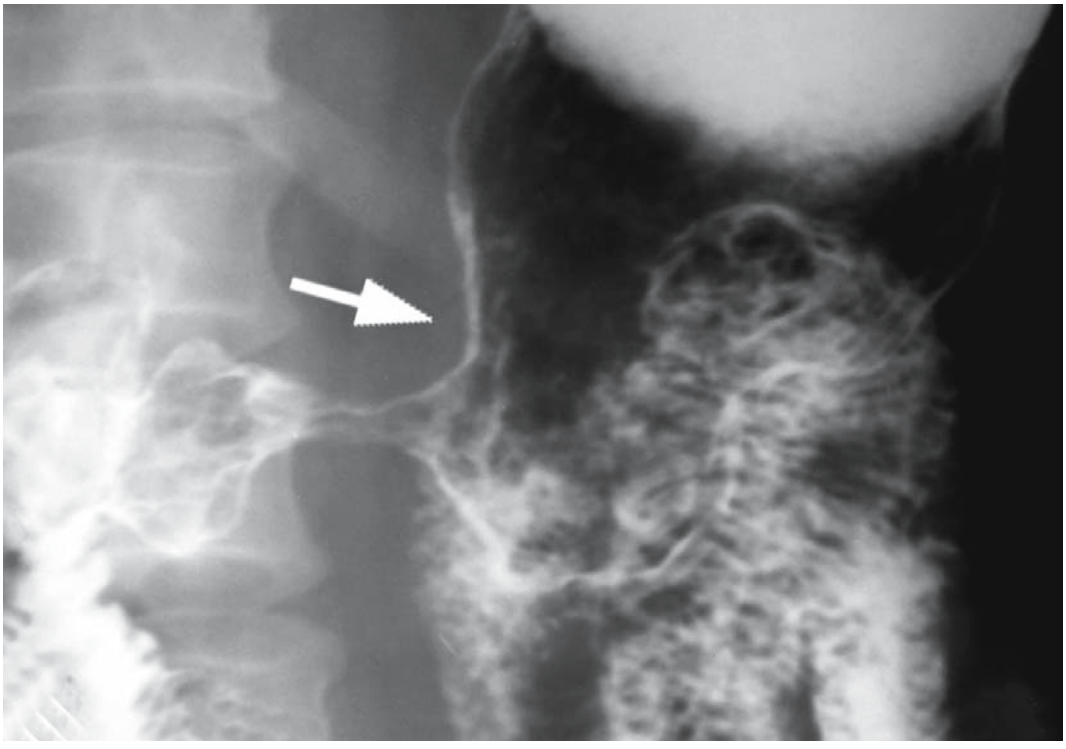
Blastomatous affection of the distal part of the stomach occurs quite frequently. Although its incidence tends to decrease, it is necessary to note that this concerns only exophytic tumors and in a small number of countries, where to human health has a high priority. The most prevalent cancers are infiltrative tumors, the occurrence of which remains at about the same level (Fig. 130).

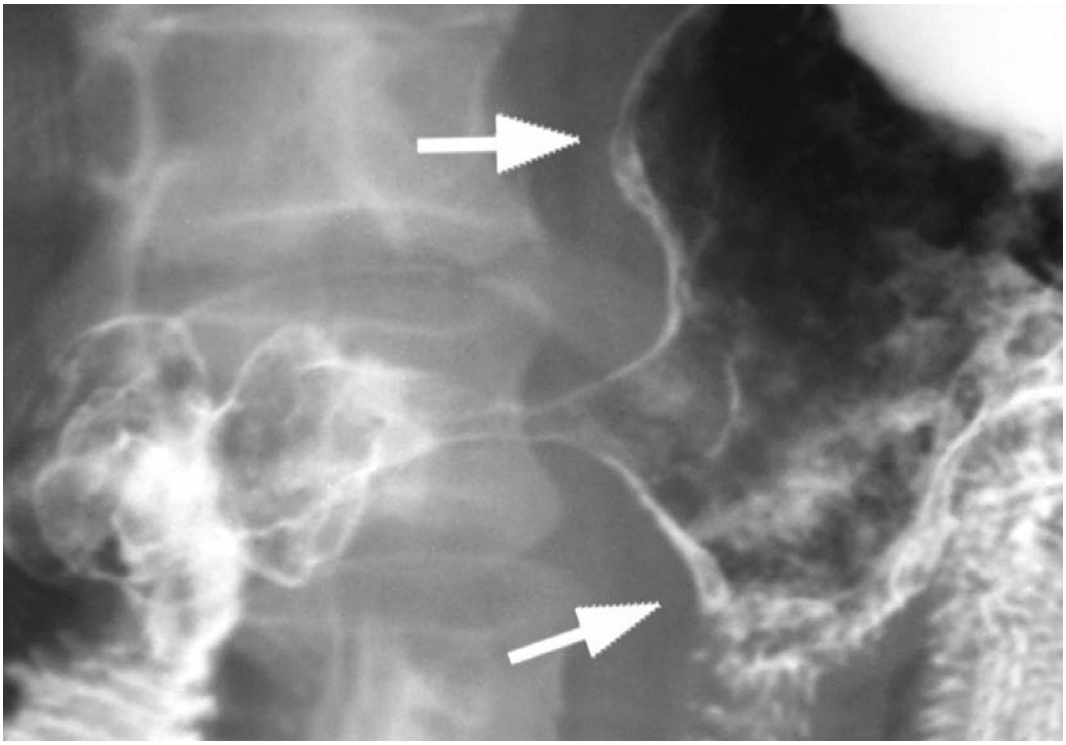
Pyloric cancers are a special problem in the detection of distal tumors. They occur less frequently

Fig. 130 a–c. Female patient U., age 62. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): cavity of the distal part is decreased, the distal part is disfigured (rigid tube), its contours are uneven, the walls are rigid. **b, c** Stomach roentgenograms (double contrast, horizontal position, anterior projection): circular infiltration of the distal part of the stomach, markedly rigid walls, thickened wall of the lesser and the greater curvatures of the stomach body due to infiltration spreading in the proximal direction (arrows). Conclusion: Infiltrative cancer of the distal part of the stomach with invasion of the stomach body. The patient was operated. Histologically, signet-ring cell carcinoma.

◀ **Fig. 130 a.**

▼ **Fig. 130 b.**





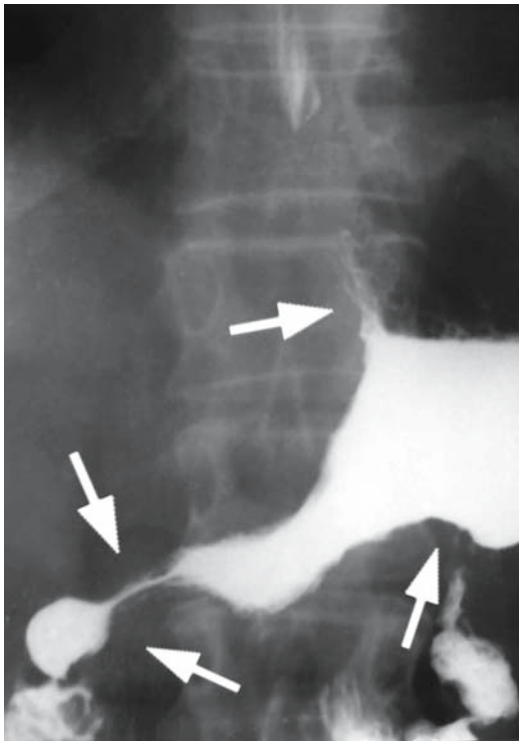
▲ Fig. 130 c.

▼ Fig. 131 a.

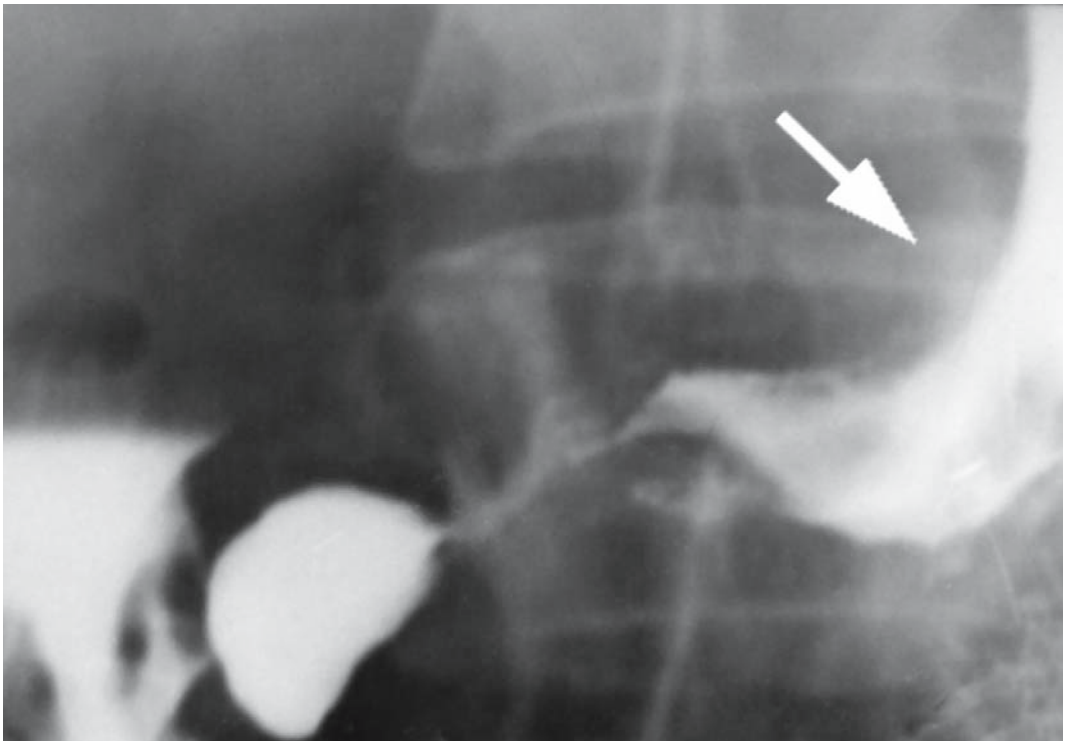
Fig. 131 a, b. Patient I., age 57. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the pyloric part is narrowed, the lesser curvature of the distal part is very short, the sinus sags, the evacuating function of the pylorus is upset. **b** Stomach roentgenogram (double contrast, horizontal position, anterior projection): marked convergence of the folds in the direction of the thickened portion of the wall of the lesser curvature in the pyloric part (arrow). Conclusion: Infiltrative cancer of the pyloric part of the stomach. The patient was operated. Histologically, signet-ring cell carcinoma.

Fig. 132 a–e. Female patient G., age 63. Diagnosis: gastric cancer. **a** Stomach roentgenogram – (tight filling, vertical position, anterior projection): cavity of the distal part and the lower third of the stomach body is decreased, the lesser curvature is short and depressed, its contours and contours of the greater curvature are uneven (arrows). **b, c** Stomach roentgenograms (tight filling, vertical position, anterior projection): the cavity is diminished, evacuation is accelerated. Uneven contours, rigid walls, the angular notch straightened (arrow). **d** Stomach roentgenogram (double contrast, horizontal position, anterior projection): the walls of the distal part and the body of the stomach are thickened and rigid due to circular intramural infiltration. Conclusion: Infiltrative cancer of the distal part of the stomach with invasion of the stomach body. **e** Endophotograph: the stomach lumen is disfigured, narrowed, the mucous membrane is grayish pink, dull, with uneven surface, readily injured on contact, the folds in this region are completely smoothed down. Histological examination of the bioptates verified signet-ring cell carcinoma of the stomach.

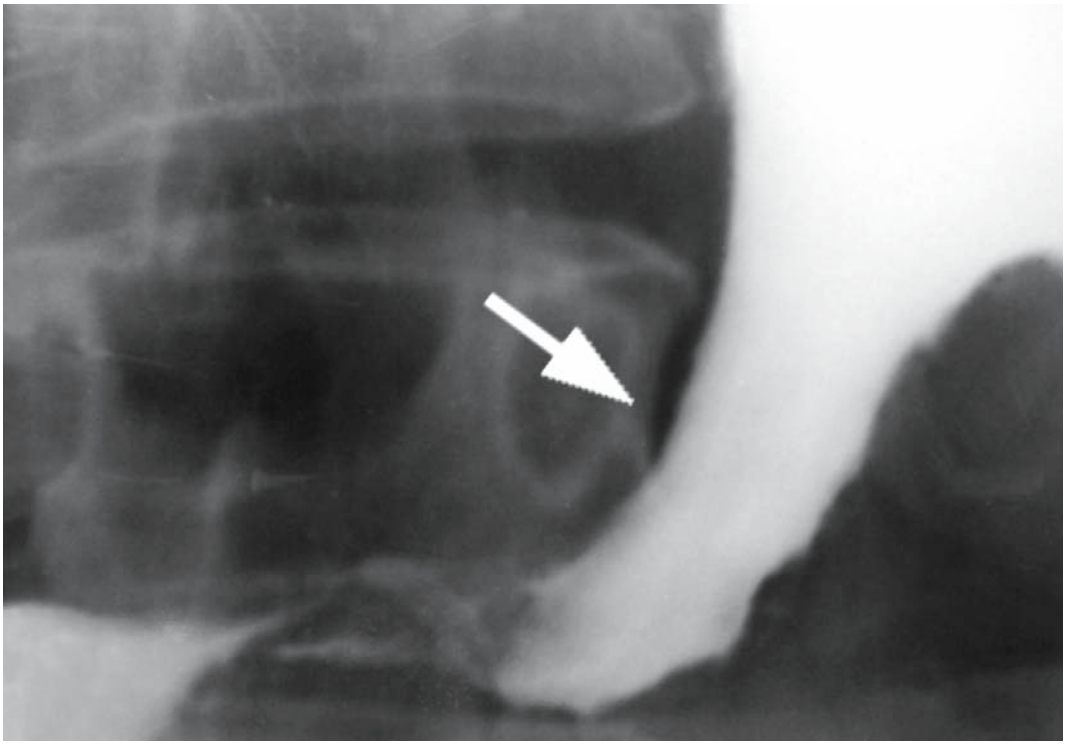
▲ Fig. 131 b.



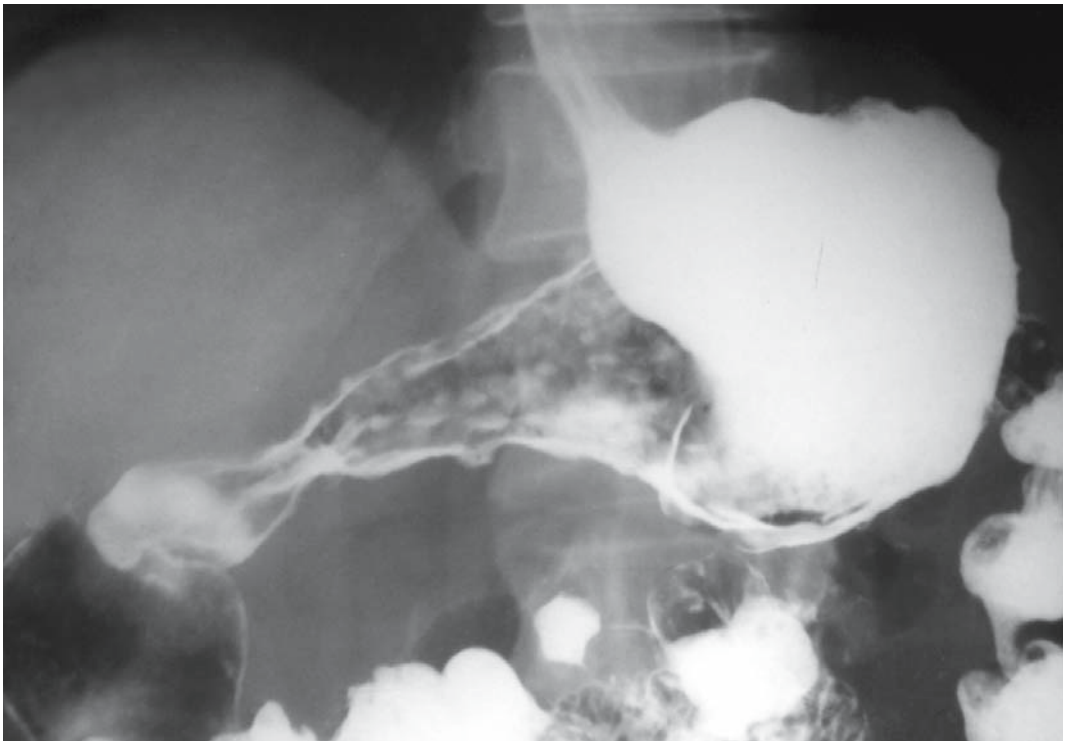
▲ Fig. 132 a.



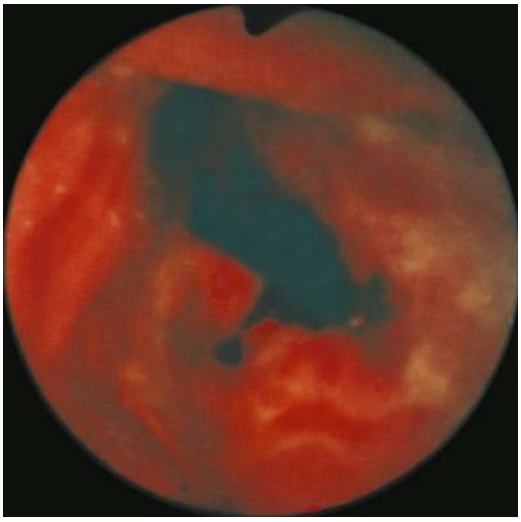
▼ Fig. 132 b.



▲ **Fig. 131 c.**



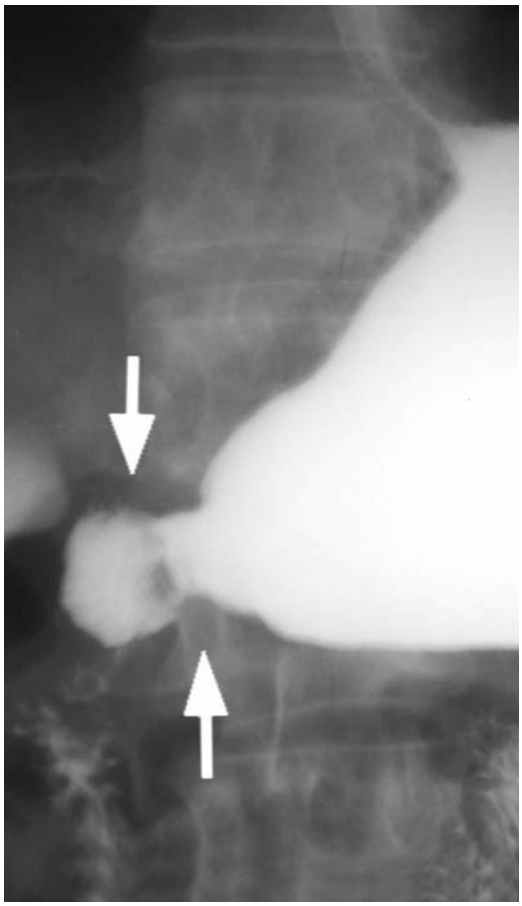
▼ **Fig. 132 d.**

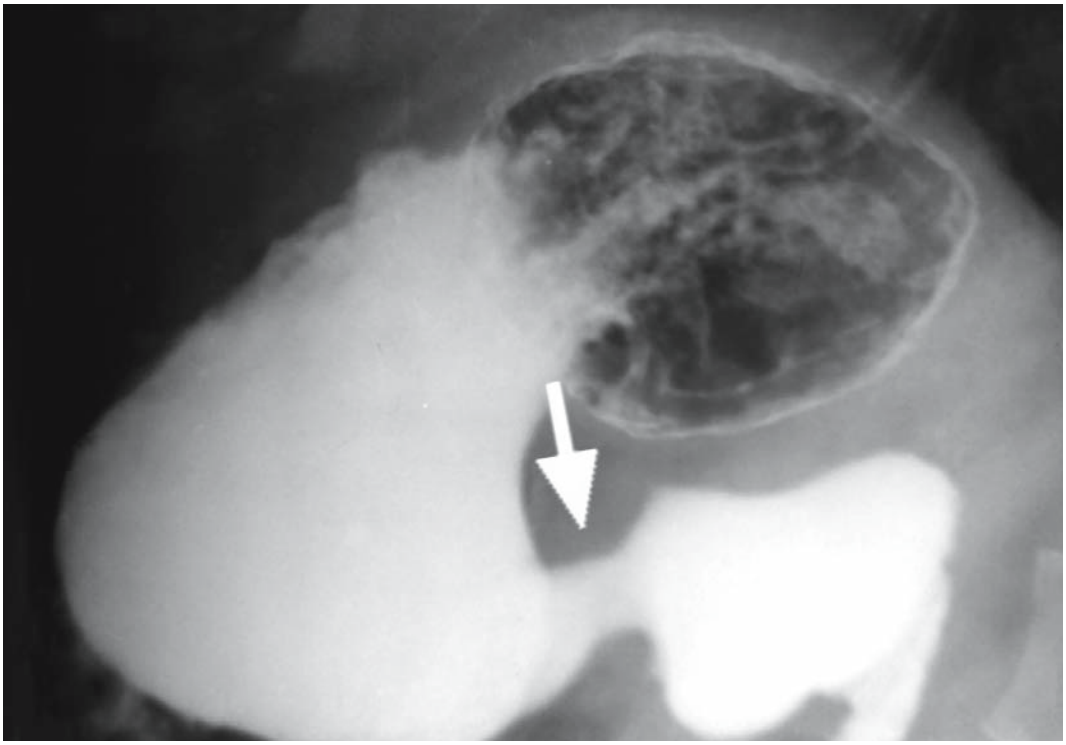


▲ **Fig. 132 e.**

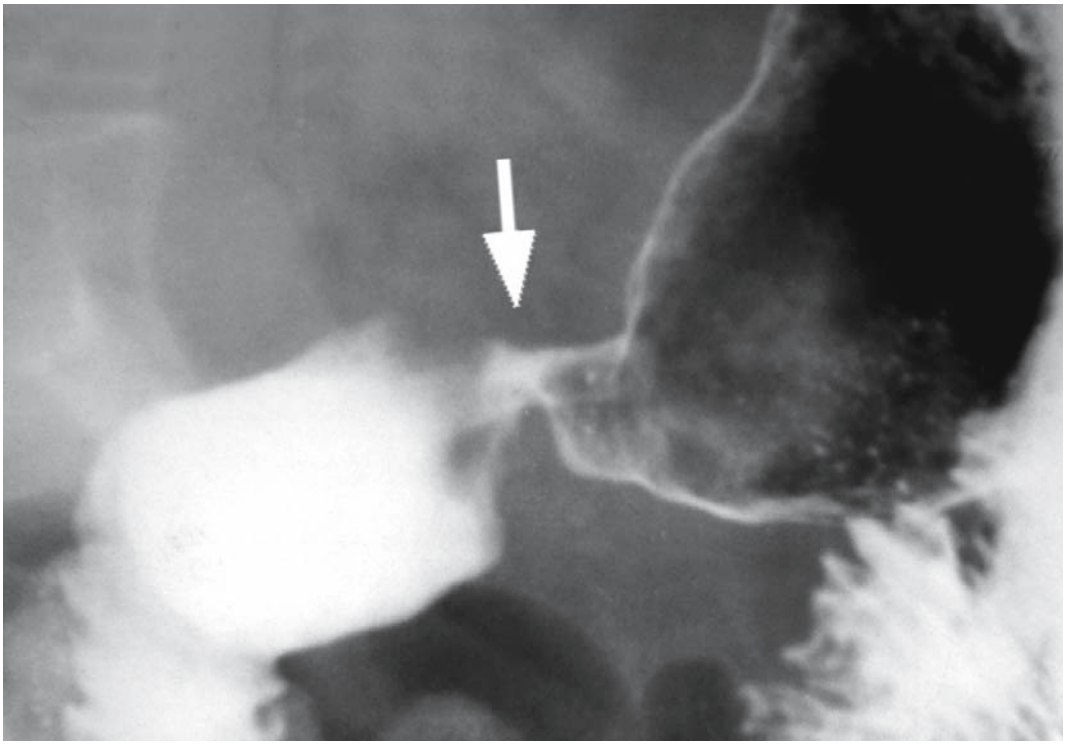
than antral cancers. According to some authors, they account for 4–16% of all gastric carcinomas. Nevertheless, it would be reasonable to discuss them as one group because of their common clinical manifestations [185, 223]. Because of their location in the pylorus, even relatively small tumors manifest by obstructive symptoms at the early stages of their growth (◘ Fig. 131). As distinct from stenosis, the pylorus may develop incompetence due to infiltration, and the patients experience constant hunger while losing weight (◘ Fig. 132). Practical experience shows that early clinical symptoms induce the patient to seek medical aid, but X-ray and endoscopic examinations sometimes prove ineffective for timely detection of the tumor in this zone; the anatomy of the pylorus is the most difficult for radiological examination and endoscopy. In addition, distal cancers must be differentiated from stenoses of the pyloroduodenal region. The diagnosis of ulcerous stenosis with obliterated or indistinct clinical signs is often established in patients with this localization of cancer (◘ Fig. 133). As the infiltrative forms of tumor growth predominate in this part, the diagnosis is even more difficult due to the specific anatomical and functional properties of this part of the stomach and the absence of marked symptoms of organic affection, interpreted in most situations to be the result of the inflammatory process. But patients often go to the doctor when their tumor is already easily palpable (◘ Fig. 134) [42]. Conspicuous manifestations of pyloroduodenal pathologies resulted in rapid accumulation of clinical data, the importance of which is difficult to overestimate even today. As knowledge of the nature of obstruction of the pyloric part grew, two aspects emerged. First, the necessity of selecting the proper degree of operative intervention implies preoperative establishment of the cause and the spread of the pathological process (◘ Fig. 135) [66]. Second, research into the role of cancers of the linitis plastica type influenced the present situation as regards identification of the nature of pyloric stenosis (◘ Fig. 136). The basic concepts of this research remain unchanged today. In current publications we meet the same point of view on the onset of the primary focus of infiltration in the prepyloric part and on tumor spreading in the proximal direction. As regards ulcers of the pyloric part, most researchers agree that they are usually malignant [10].

▼ **Fig. 133 a.**

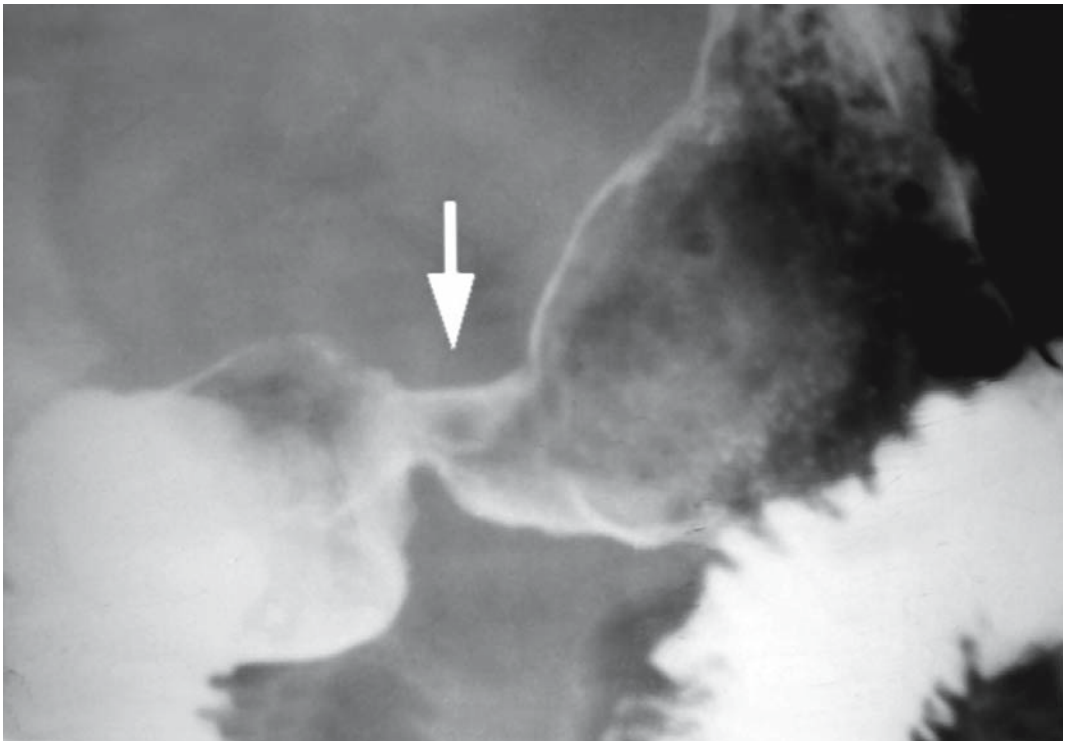




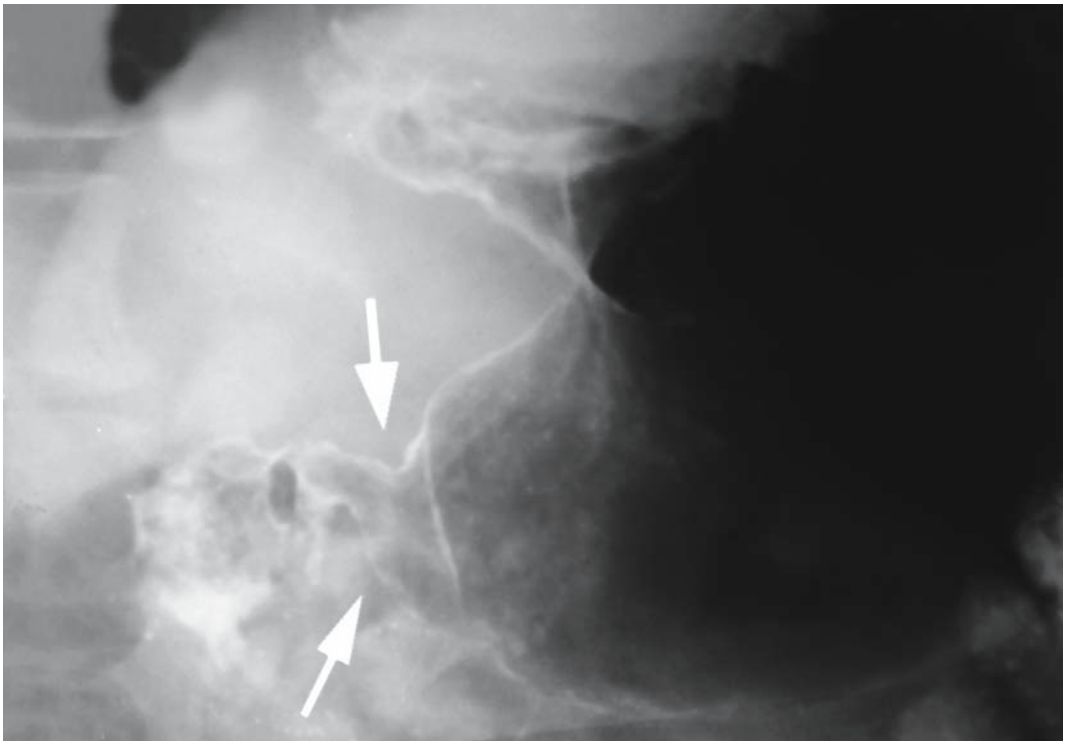
▲ **Fig. 133 b.**



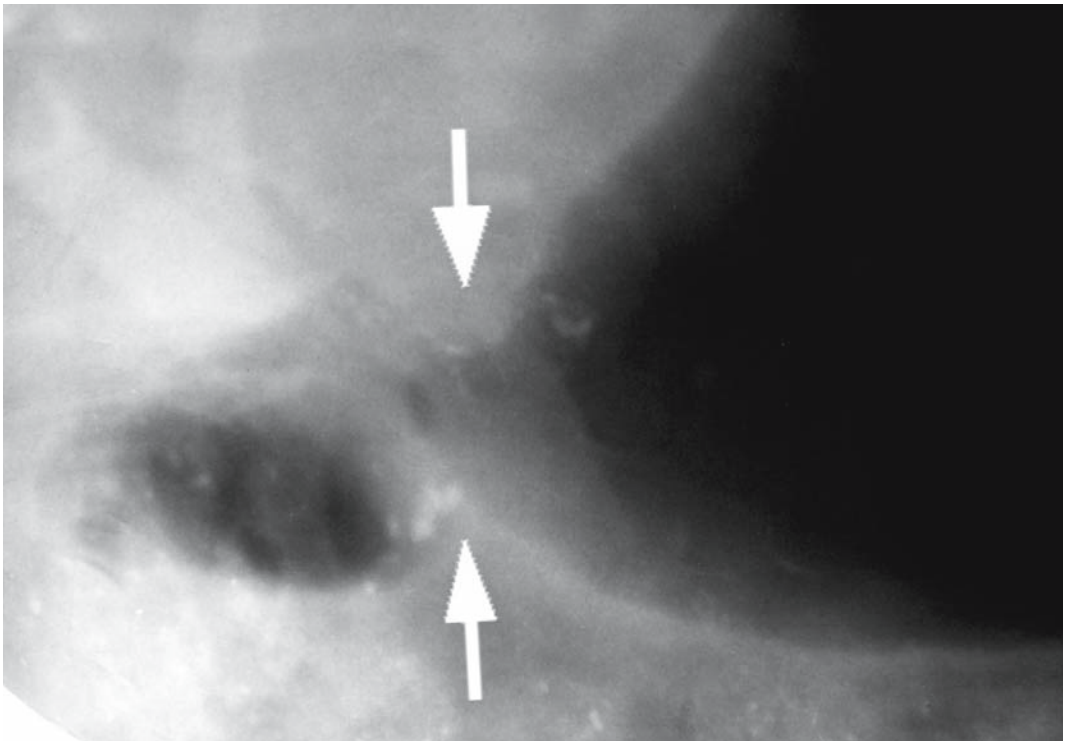
▼ **Fig. 133 c.**



▲ Fig. 133 d.



▼ Fig. 133 e.

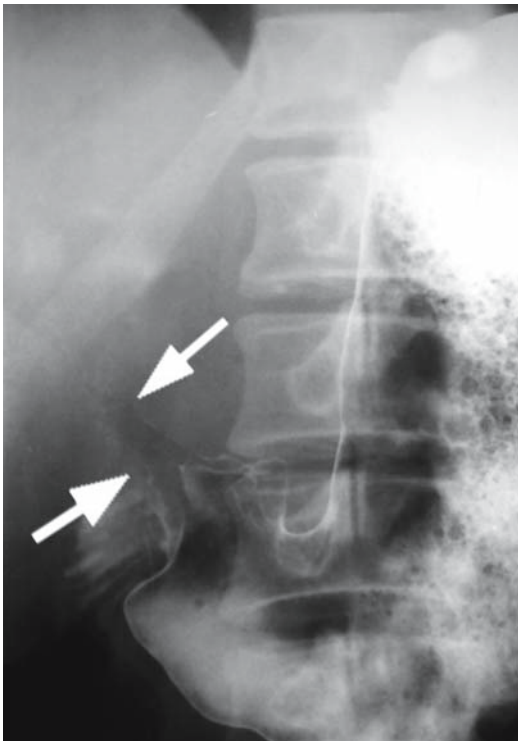


▲ Fig. 133 f.

▼ Fig. 134 a.

Fig. 133 a–e. Patient L., age 65. Diagnosis: gastric cancer. Complaints of occasional vomiting, usually in the second half of the day. The feeling of overfilled stomach after meals. Anamnestic data: endoscopy conducted about 2 months earlier revealed a small ulcer in the pyloric part of the stomach. Histological examination of bioptates failed to find tumor cells. Control endoscopies did not reveal positive dynamics. X-ray examination of the stomach was recommended. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the pyloric part is disfigured, narrowed, the walls are rigid (arrows). **b** Stomach roentgenogram (tight filling, horizontal position, left posterior oblique projection): the pyloric part is disfigured (rigid tube) (arrow). **c, d** Stomach roentgenograms (double contrast, horizontal position, anterior projection): the pyloric part is disfigured, the walls are rigid, the lesser curvature has the shapes of a rigid platform with a depot of contrast medium (arrow). **e, f** Stomach roentgenograms (double contrast, horizontal position, anterior projection) after additional ingestion of a gas-producing mixture and practically complete evacuation of the barium sulfate suspension: the walls of the pyloric part of the stomach are thickened and rigid due to circular intramural infiltration (arrows). Conclusion: Infiltrative-ulcerous cancer of the pyloric part of the stomach. The patient was operated. Histologically, signet-ring cell carcinoma.

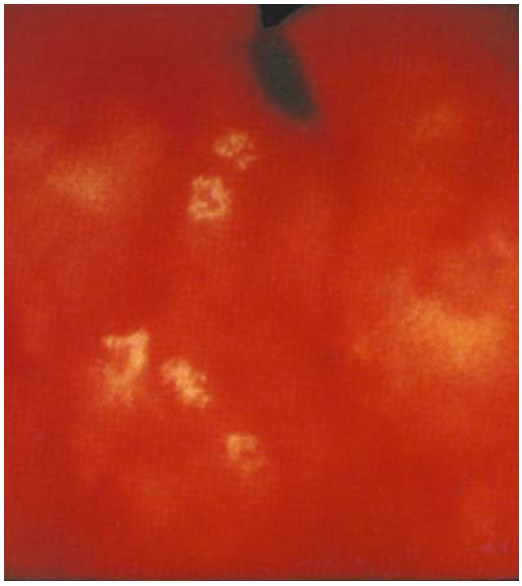
Fig. 134 a–c. Patient K, age 46. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the pyloric part and the distal half of the antral part are narrow, evacuation function of the pylorus is upset, the



▲ **Fig. 134 b.**

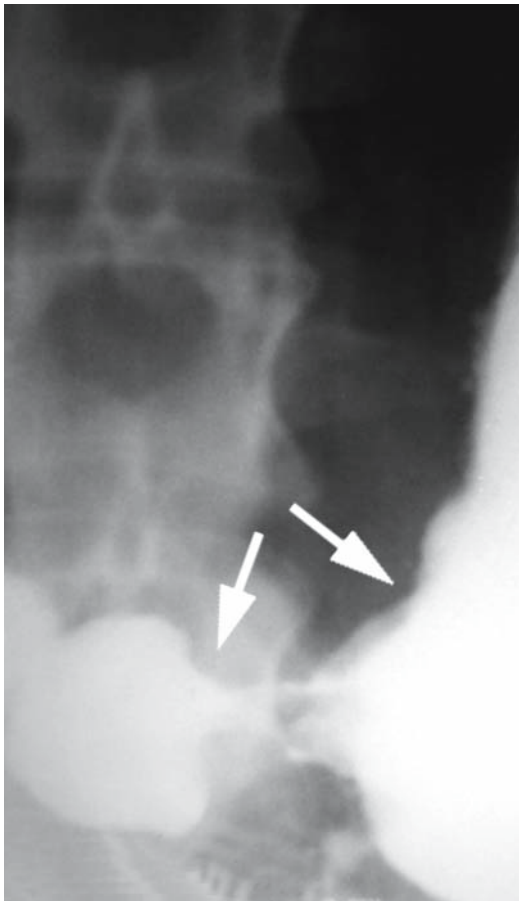
walls are rigid. **b** Stomach roentgenogram (double contrast, horizontal position, anterior projection): the pyloric part and the distal half of the antral part are narrowed, the walls are thickened and rigid due to circular intramural infiltration (arrows). Conclusion: Infiltrative cancer of the pyloric part of the stomach with invasion of the antral part of the stomach. **c** Endophotograph: the pyloric part of the stomach is very narrow and disfigured, the mucous membrane is spotted: grayish pink spots against the background of hyperemia; the surface is smooth and glassy. Histological examination of the bioptates verified signet-ring cell carcinoma.

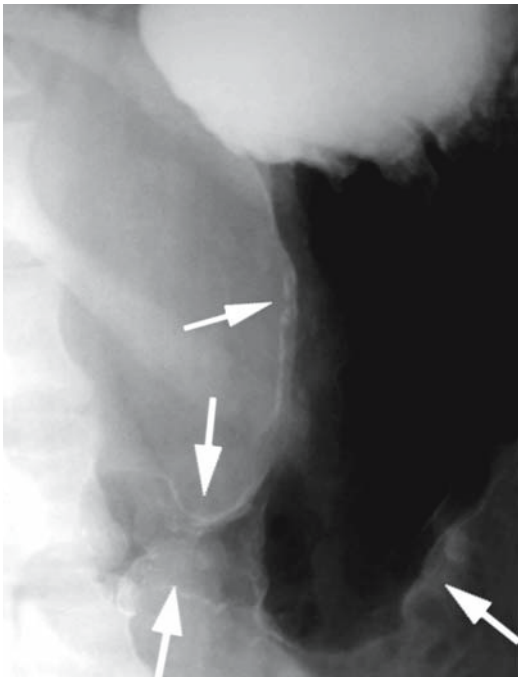
Fig. 135 a–c. Patient S., age 59. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): antral part of the stomach is disfigured (hourglass), the angular notch is straightened, contours are uneven (arrows). **b** Stomach roentgenogram (double contrast, horizontal position, anterior projection): walls of the antral part, the sinus, and the stomach body are thickened and rigid due to diffuse circular intramural infiltration (arrows). Conclusion: Infiltrative cancer of the antral part of the stomach with involvement of the stomach body. **c** Endophotograph: the antral part of the stomach is strongly disfigured and narrowed. The mucous membrane is scarlet, infiltrated, with uneven surface. Ulceration with tuberous firm margins and flat uneven floor covered with necrotic mass is seen on the greater curvature. Histological examination of bioptates verified signet-ring cell carcinoma.



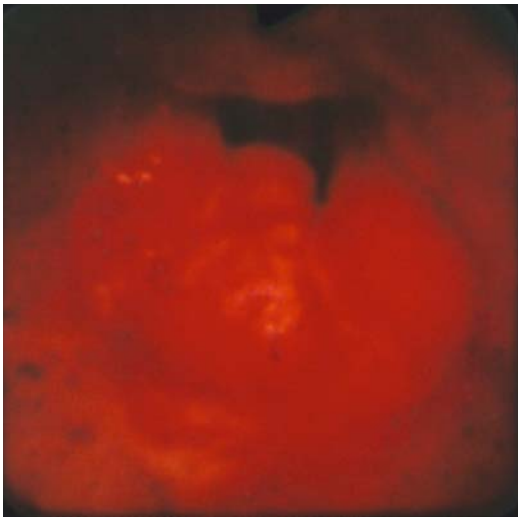
▲ **Fig. 134 c.**

▼ **Fig. 135 a.**



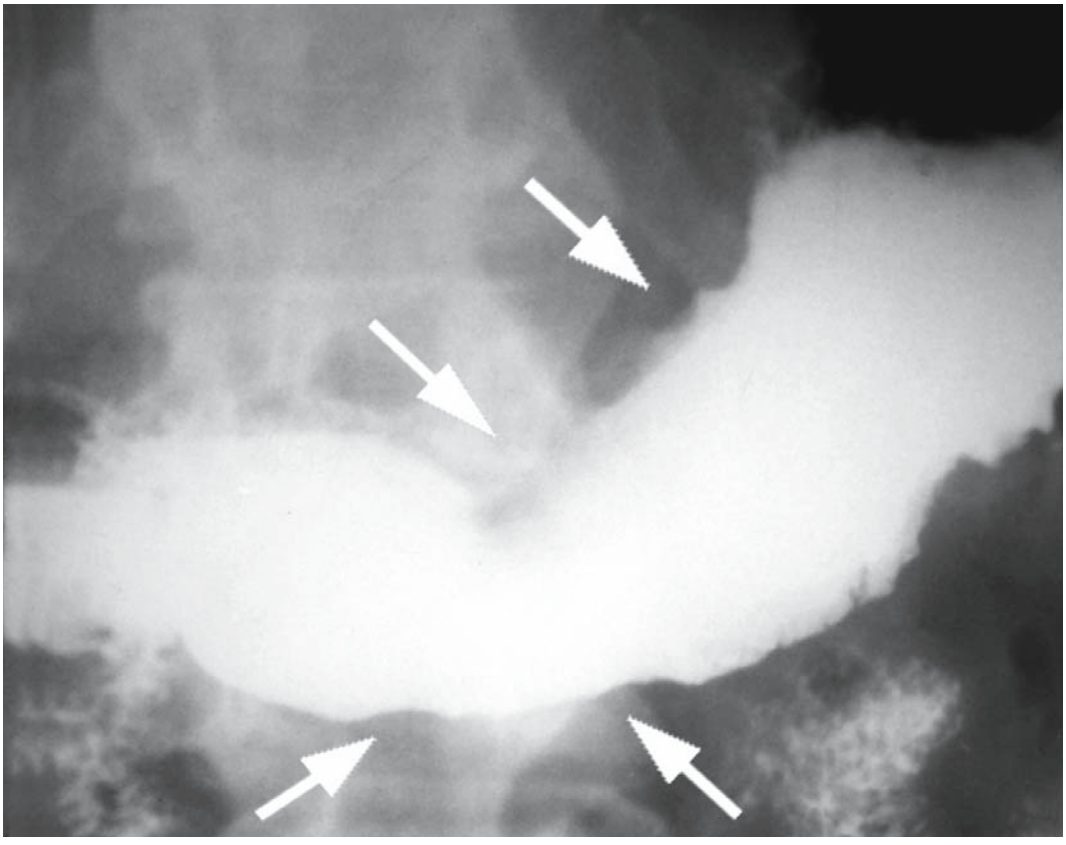


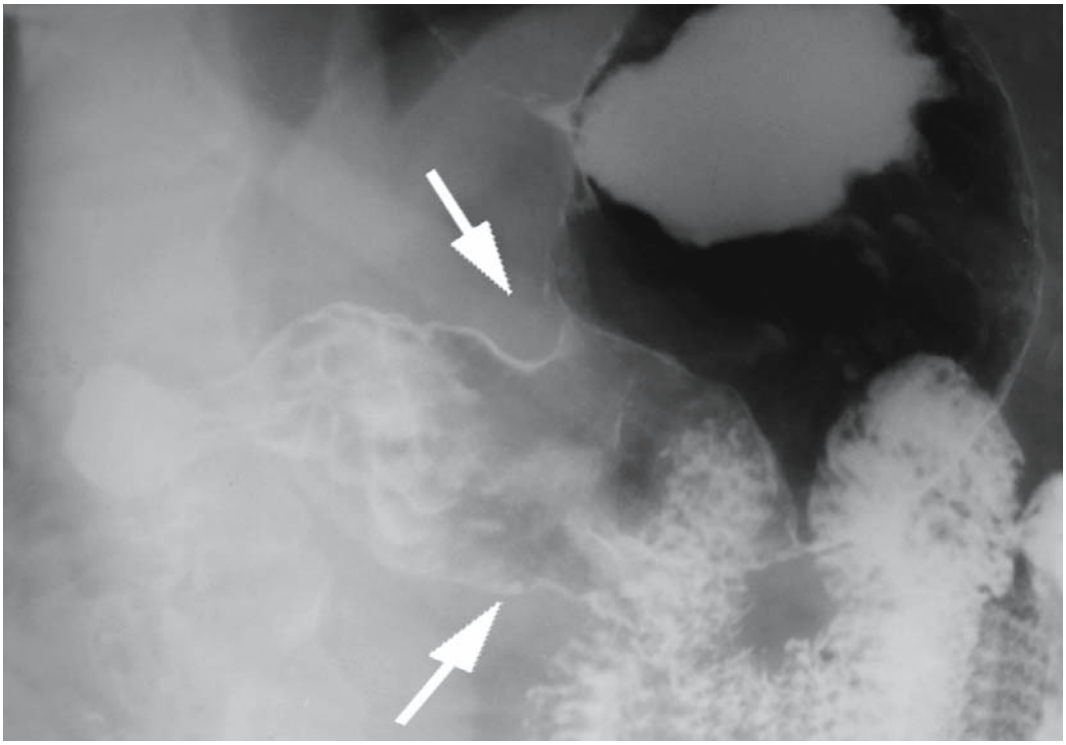
◀ **Fig. 134 b.**



▲ **Fig. 135 c.**

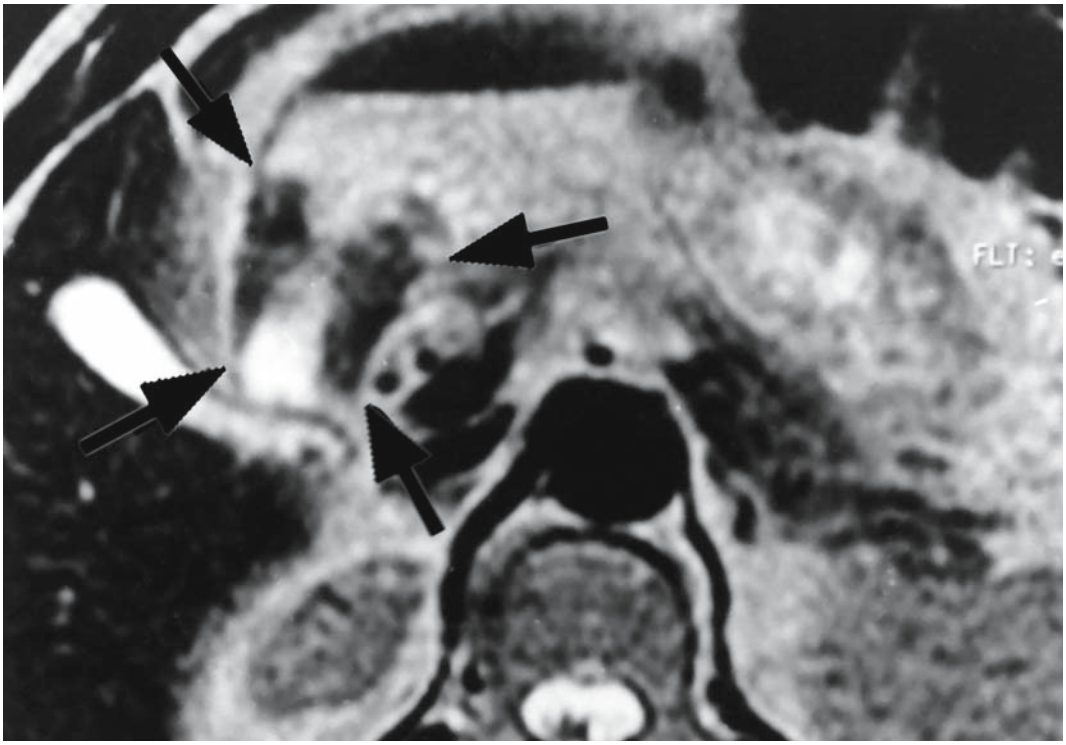
▼ **Fig. 136 a.**





▲ Fig. 136 b.

▼ Fig. 137 a.



▲ **Fig. 137 b.**

▼ **Fig. 137 c.**

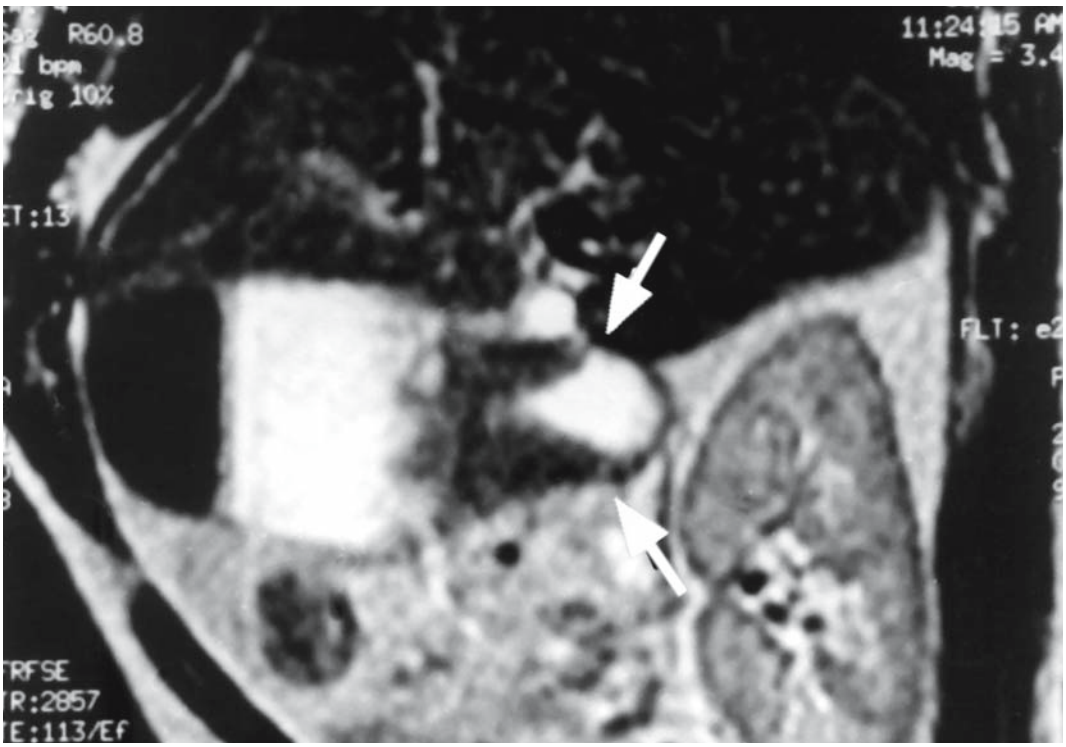


Fig. 136 a, b. Patient M., age 68. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): uneven contours of the distal part and the body of the stomach; straightened angular notch (arrows). **b** Stomach roentgenogram (double contrast, horizontal position, anterior projection): the walls of the distal part and the body of the stomach are thickened and rigid due to diffuse circular intramural infiltration (arrows). Conclusion: Infiltrative cancer of the distal part of the stomach with spread onto the stomach body. The patient was operated. Histologically, adenocarcinoma with the signet-ring cell component.

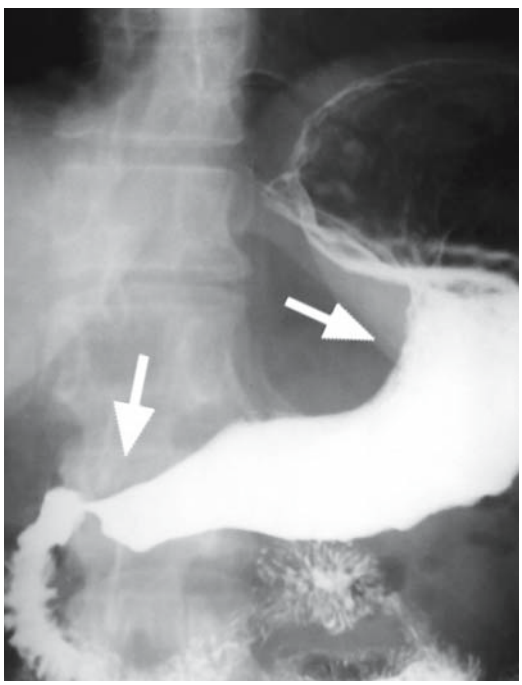
Fig. 137 a–c. Patient K., age 61. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the cavity is strongly ectatic, the fasting stomach contains much fluid and mucus; pronounced evacuation disorder. In the absence in the patient's anamnesis of gastroduodenal ulcer, the X-ray picture is more likely to be interpreted as a tumor affection of the pyloric part of the stomach. In order to verify etiology of the so-called stenosis of the pyloric part of the stomach, endoscopy with multiple biopsy was recommended. Endoscopy revealed severely narrowed upper part of the stomach. Histological examination of the bioptates failed to find tumor cells. The patient was examined by MRI. **b** MR image of the stomach (axial projection, level of the pyloric part of the stomach, T2 image): the pyloric part of the stomach is circularly narrowed due to intramural infiltration of its walls for a length of about 45 mm with the maximum wall thickness to 20 mm; the inner outline of the narrowed part is uneven and blurred, the outer sufficiently distinct. Signs of involvement of the perigastric cellular tissue are absent (arrows). **c** MR image of the stomach (sagittal projection, level of the pyloric part of the stomach, T2 image): more distinct is the lower border of the intramural infiltration (arrows). Conclusion: Infiltrative cancer of the pyloric part of the stomach. The patient was operated. Histologically, non-differentiated cancer. As seen from this example, MRI of the stomach proved to be the method by which it was possible to verify the nature of the so-called stenosis of the pyloric part of the stomach before operation and to confirm findings of the traditional roentgenological examination. Endoscopy failed to verify the nature of the so-called stenosis.

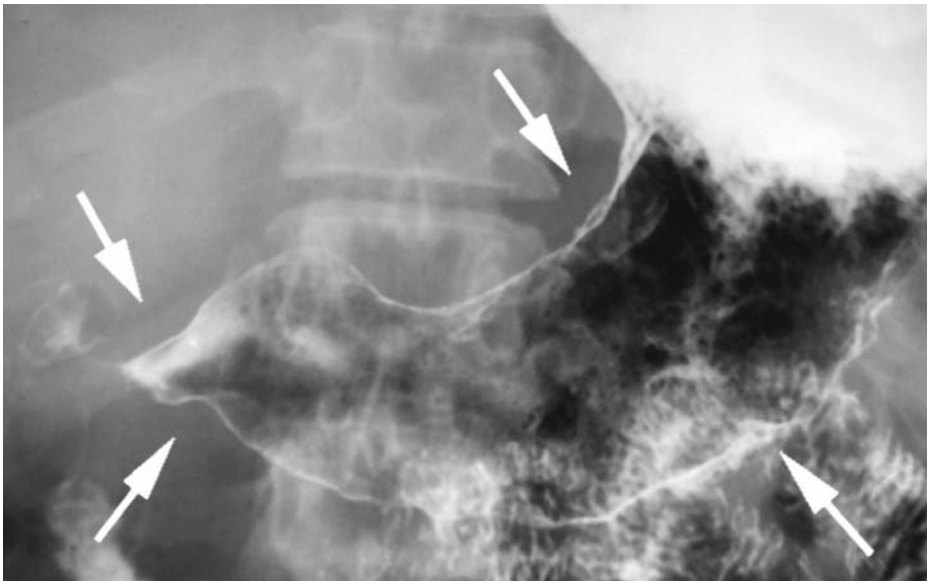
Fig. 138 a, b. Female patient Sh., age 58. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the cavity is decreased, the angular notch is straightened, the lesser curvature is shortened and depressed (arrows); **b** Stomach roentgenogram (double contrast, horizontal position, anterior projection): walls of the distal part and body of the stomach are thickened and rigid due to circular intramural infiltration (arrows). Conclusion: Infiltrative cancer of the distal part and the body of the stomach. The patient was operated. Histologically – signet-ring cell carcinoma.

The need for early diagnosis of gastric cancer stimulated oncologists to make a more thorough study of pyloric cancers. Simultaneously, they evaluated the potentials of X-ray methods, which were directed at the functional symptoms (disordered evacuation, residues of barium sulfate suspension within a defined lapse of time, etc.) because of the insignificant number of determinable morphological signs of organic affection. But in our studies of cancer and ulcer stenosis we arrived at the conclusion that the current semiotics of such affections, based mostly on signs of far-advanced cancers, cannot adequately lead to an early diagnosis, nor can it differentiate the two conditions (Fig. 137). The pyloroduodenal zone can be the site of localization of rarer diseases, such as tuberculosis, syphilis, rigid antral gastritis, or erosive gastritis. In addition, difficulties can arise in the presence of perigastric commissures and depressions in the so-called hypertrophic pylorostenosis, secondary changes in the gastroduodenal junction in patients with benign or malignant affection of the hepato-pancreatic-duodenal zone. Unfortunately, we must admit that at present, these conditions are identified only during surgery, because it is sometimes impossible to verify the diagnosis using available technical facilities.

The main reason for this unsatisfactory situation is that these tumors are mostly endophytic, and not adequately covered by roentgenological and endoscopic semiotics (Fig. 138). This is a difficult problem. Stomach deformations, which occur in

▼ **Fig. 138 a.**





◀ Fig. 138 b.

such situations, can interfere with endoscopy (which is used by most oncologists) and biopsy. The limited potentials of fibergastroscopy, which gives a rather non-specific picture as regards differential diagnosis, and insufficient knowledge of radiological diagnosis (in some cases, sheer ignorance of it), makes clinicians take unusual measures such as laparotomy, or frequent and futile attempts to obtain histological confirmation by examining bioptates taken during endoscopy. M.S. Levin et al. (1990) provide a good illustration of such a situation: A patient was operated on only when the diagnosis was established after the fifth attempt to obtain a positive result of endoscopic biopsy, 18 months after the patient's first visit [184].

Serious difficulties arise during a traditional X-ray examination, because so-called stenosis of the pylorus is usually accompanied by stomach ectasia owing to the presence of food residues, liquid, and mucus. Early diagnosis of tumors in such localizations is also very difficult due to the greatly diluted barium sulfate suspension and the infeasibility of it tightly filling the pyloric part (◘ Fig. 139).

We have formulated a basic radiology semiotics for the pathology under discussion based on signs of infiltrative growth, which can be present even in cases with insignificant affection of the stomach wall. The current traditional orientation toward the signs of diffuse tumor is the main reason for an unfavorable prognosis, even when the diagnosis is successful. This is true for both roentgenological and endoscopic examinations [48, 55].

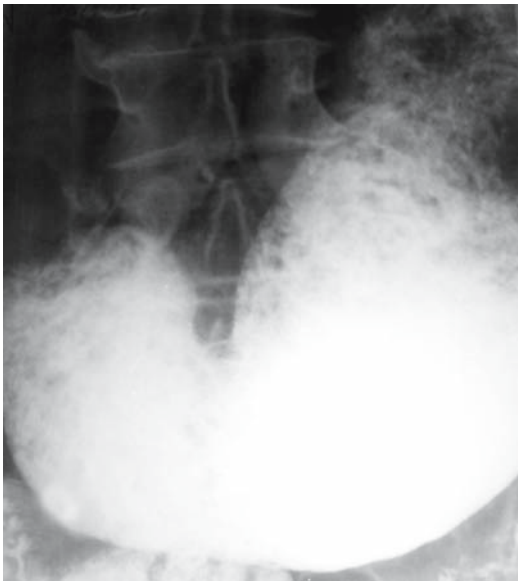
The recent tendency to decline radiological diagnosis leads to dramatic results. The widely used fibergastroscopy often fails to establish the true cause of the patient's deteriorated condition and only states the presence of ulceration and erosion, or even finds »intact« mucous membrane in this part of the stomach. Common biopsy proves useless in cases with submucous tumors, which do not manifest on the surface of the mucous membrane.

In such cases, X-ray findings acquire major importance in the diagnostic algorithm. But due to the small size of the tumor, the traditional techniques do not always supply sufficient information. Determination of thickness and elasticity of the walls using double-contrast radiology becomes especially important here. If the tumor is small, it is impossible to detect the presence of the well-known signs such as concentric narrowing or rigidity of walls of the antral part of the stomach, which suggest the spread of malignancy not only to the pyloric part but also to the neighboring structures. The situation becomes even more serious in the presence of concurrent peptic ulcers, which, together with erosive gastritis, mask submucous tumors and lead to an incorrect radiological and endoscopic diagnosis (◘ Fig. 140).

Fig. 139 a–f. Female patient P., age 71. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the stomach contains much fluid, mucus, and food residue; the evacuation function of the pylorus is upset. **b** Stomach roentgenogram (tight filling, vertical position, anterior projection) after ingestion of an additional portion of contrast medium: the pyloric part is unevenly narrowed, its walls are rigid, vigorous peristaltic activity of the intact parts of the stomach is seen. **c, d** Stomach roentgenograms (tight filling, vertical position, anterior projection): pyloric part is unevenly narrowed due to circular infiltration of its walls (arrow); the evacuation function of the pylorus is upset. **e** Stomach roentgenogram (double contrast, horizontal position, anterior projection): walls of the pyloric part are thickened and rigid due to circular intramural infiltration (arrow). Conclusion: Infiltrative cancer of the pyloric part of the stomach. **f** Endophotograph: pyloric part of the stomach is disfigured, greatly narrowed (resembling a sleeve), the mucous membrane in this region is grayish pink, tuberous, with a fibrin coat; the pylorus is not differentiated. Histological examination of the bioptates taken during endoscopy verified signet-ring cell carcinoma.

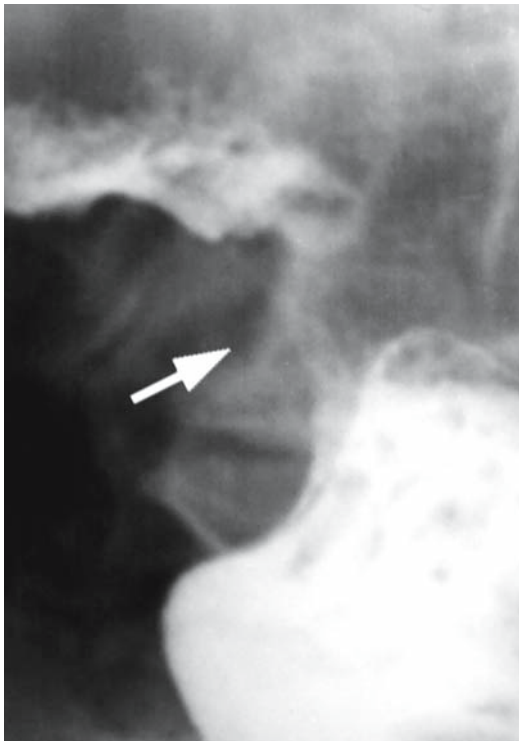
Fig. 140 a–d. Patient K., age 53. Diagnosis: gastric cancer. **a, b** Stomach roentgenograms (tight filling, vertical position, anterior projection): pyloric part is unevenly narrowed due to circular infiltration of its walls; the evacuation function of the pylorus is normal. **c** Stomach roentgenogram (double contrast, horizontal position, anterior projection): walls of the pyloric part are thickened and rigid due to circular intramural infiltration. Conclusion: Infiltrative cancer of the pyloric part of the stomach. **d** Endophotograph: pyloric part of the stomach is disfigured, narrowed like a sleeve, the mucous membrane is hyperemic, with rough surface and a fibrin coat. Histological examination of the bioptates taken during endoscopy verified non-differentiated cancer.

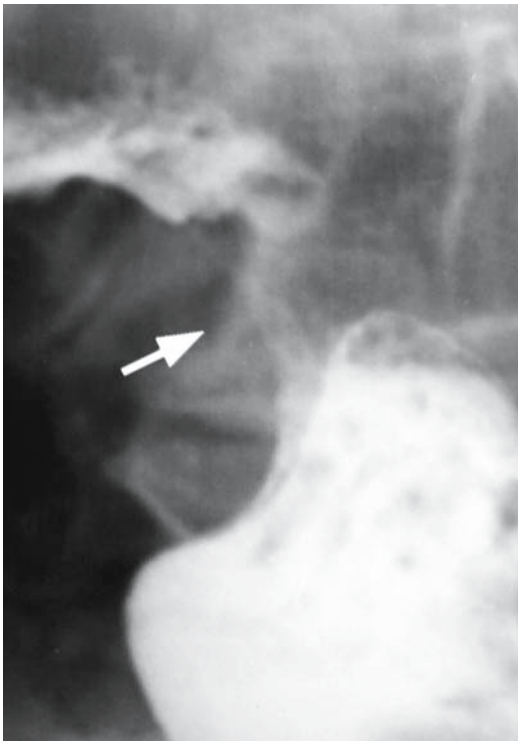
▼ **Fig. 139 a.**



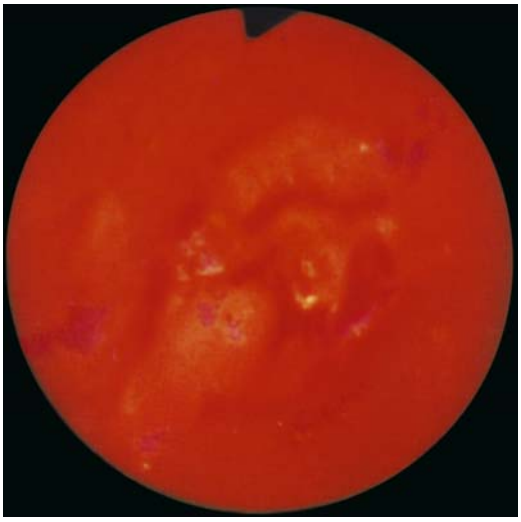
▲ **Fig. 139 b.**

▼ **Fig. 139 c.**



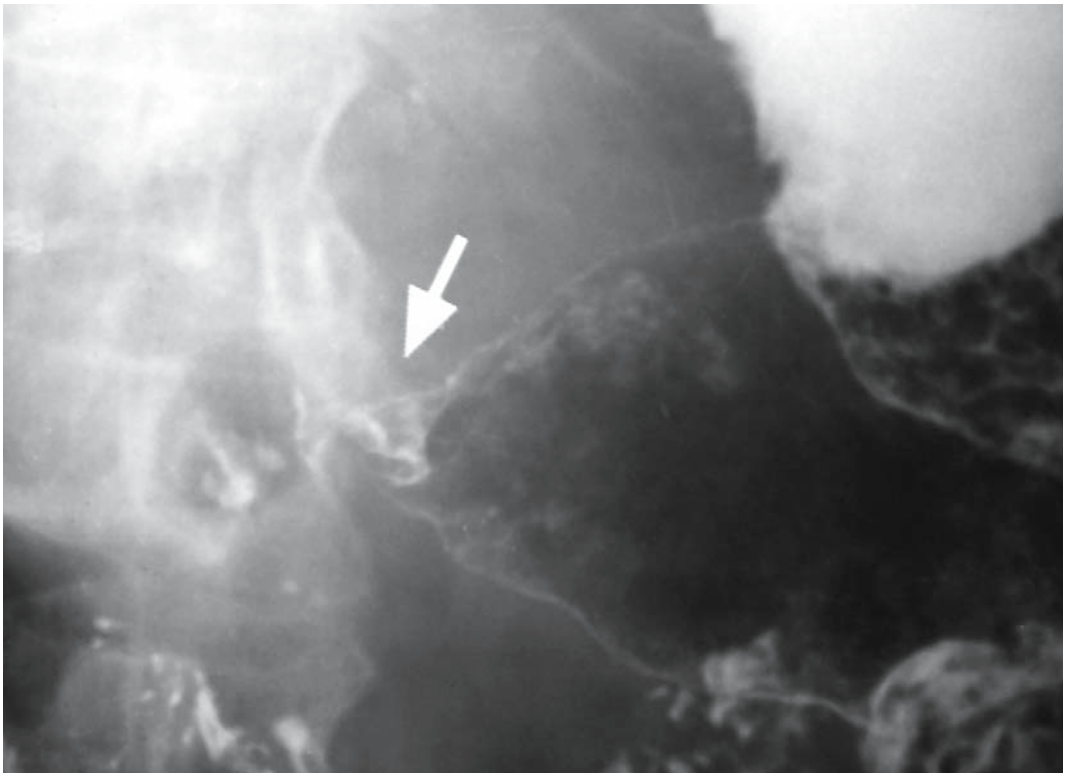


◀ **Fig. 139 d.**

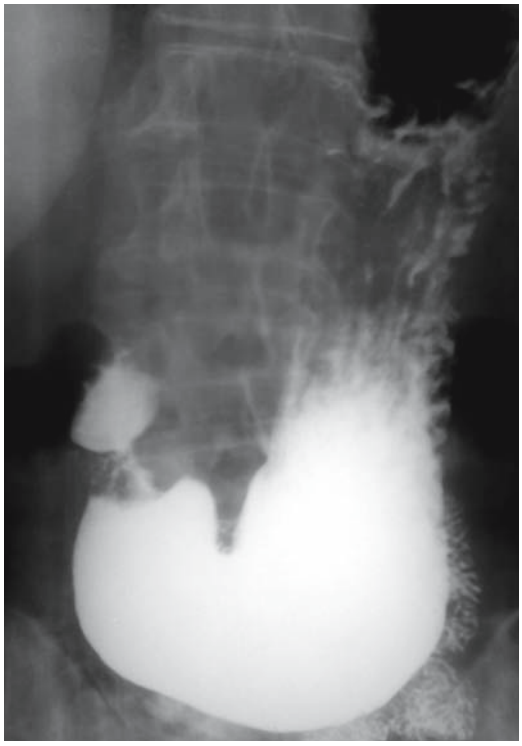


▲ **Fig. 139 f.**

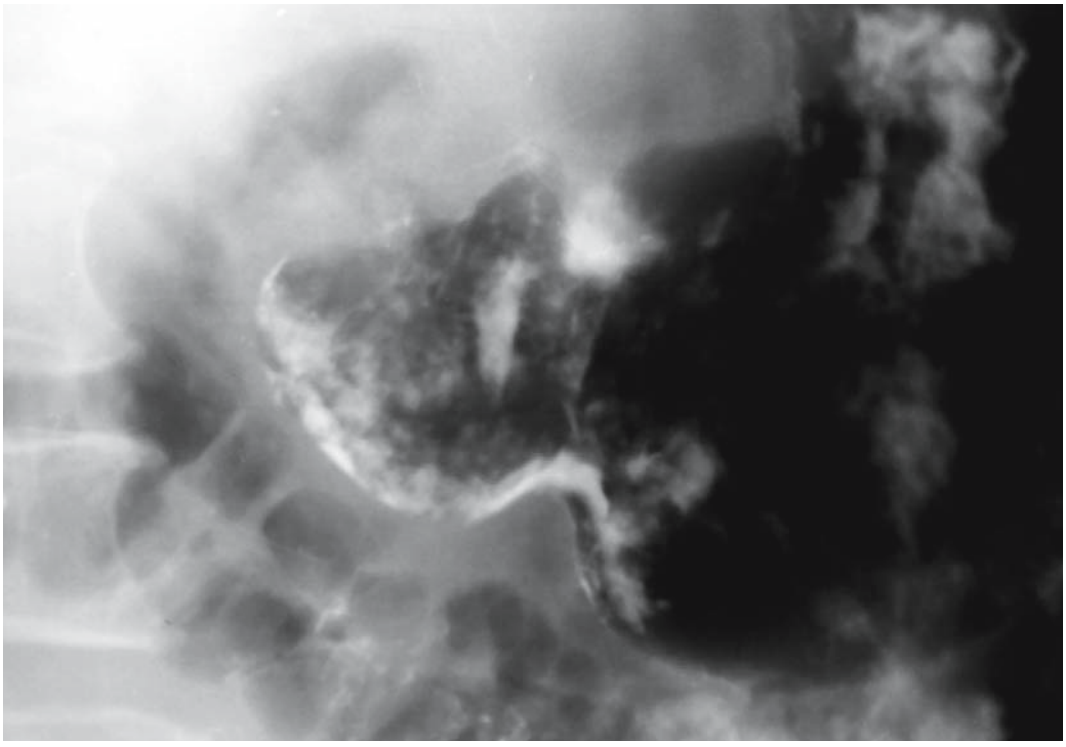
▼ **Fig. 139 e.**



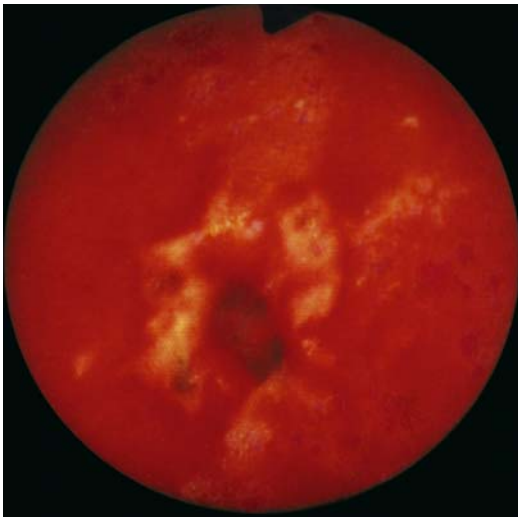
▲ Fig. 140 a.



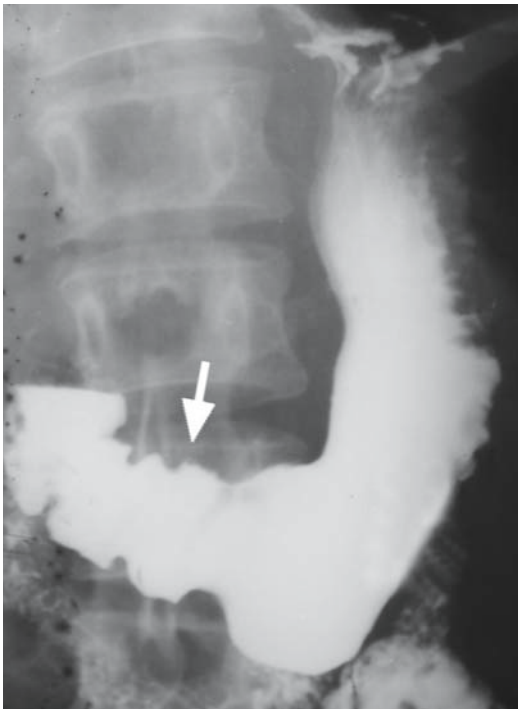
▲ Fig. 140 b.



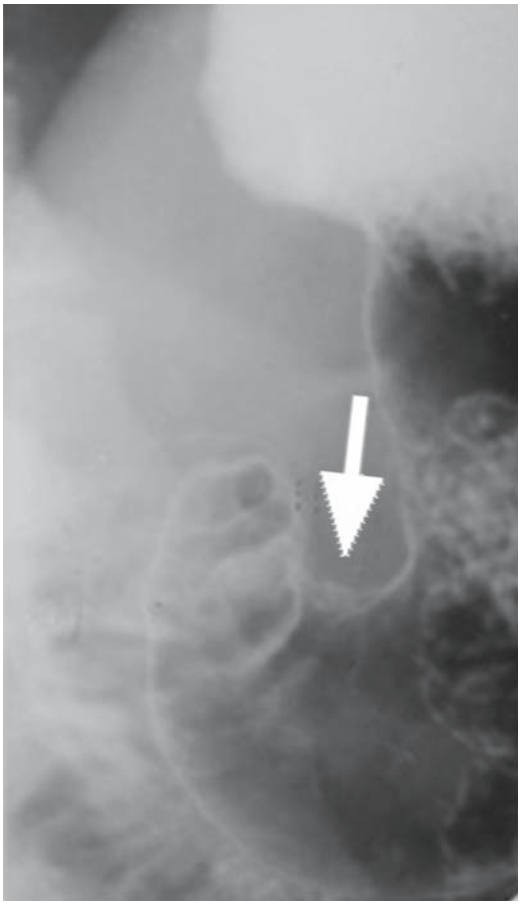
▼ Fig. 140 c.



▲ Fig. 140 d.



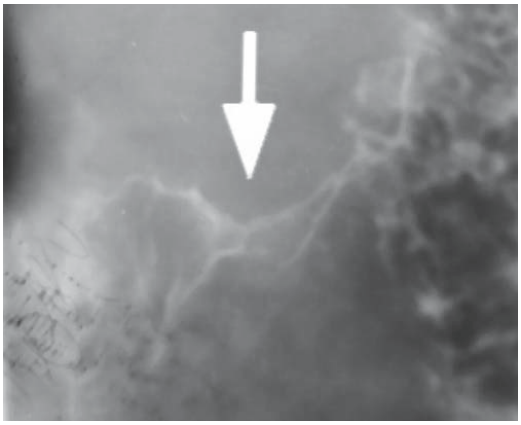
▼ Fig. 141 a.



▲ Fig. 141 b.

Nevertheless, modern radiological diagnosis is able to solve these difficulties, which only appear to be unsurpassable obstacles to a correct and early diagnosis of cancer of the prepyloric part of the stomach. Here we stress again that good visualization of the morphological substrate can be obtained only with certain specific techniques of examination. One of these is target imaging of the pyloroduodenal region in the vertical and horizontal positions with the maximum possible tight filling. This technique can be used to estimate the contours, the elasticity of the wall, its rigidity, the extent of the involved area, and the presence of ulcers. At the same time, during examination in the vertical position, tight filling of the pylorus is often difficult in the presence of liquid, mucus, and food residues. Therefore, radiography in the vertical position should preferably be done after the patient is raised from the horizontal position, which is optimal for filling this region.

The double-contrast investigation plays an important role in the diagnosis of distal cancer. It can give the image of the tumor in its true size because the tumor becomes »trimmed« with the intact wall of the stomach as it is inflated with air. Imaging of the stomach wall with double-contrast radiology



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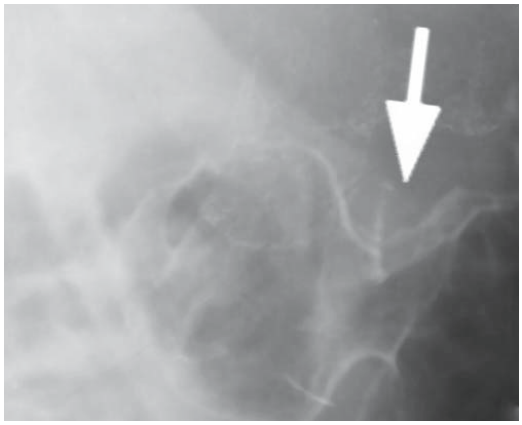


▲ Fig. 141 c.

Fig. 141 a–c. Patient V., age 58. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): uneven contour of lesser curvature of the antral part (arrow). **b** Stomach roentgenogram (double contrast, horizontal position, right oblique projection): wall of the lesser curvature of the antral part is thickened and rigid due to intramural infiltration (arrow). **c** Stomach roentgenograms (double contrast, horizontal position, right oblique projection): the walls of the prepyloric part are thickened and rigid over a length of about 2 cm due to intramural infiltration (arrows). Conclusion: Initial infiltrative cancer of the distal part of the stomach. The patient was operated. Histologically, adenocarcinoma with the signet-ring cell component.

makes it possible to differentiate between benign stenosis and malignant tumor. In patients with cancer, as distinct from cicatricial-ulcerous stenosis, the thickness of the walls in the distal part of the stomach greatly exceeds normal thickness. Concerning these signs of the blastomatous process, we must point out that one particular sign should not be considered separately from others. Clinical manifestations must also be taken into consideration in such situations.

While discussing pathologies of the pylorus, we would like to dwell on the spread of tumor in the distal direction, i.e., to the bulb and the post-bulbar part of the duodenum. The classical concept of the infiltrative process of the linitis plastica type suggests a casuistic possibility of total affection of the gastrointestinal tract: Spread of the process in the distal direction is connected largely with blastomatous lymphangitis.

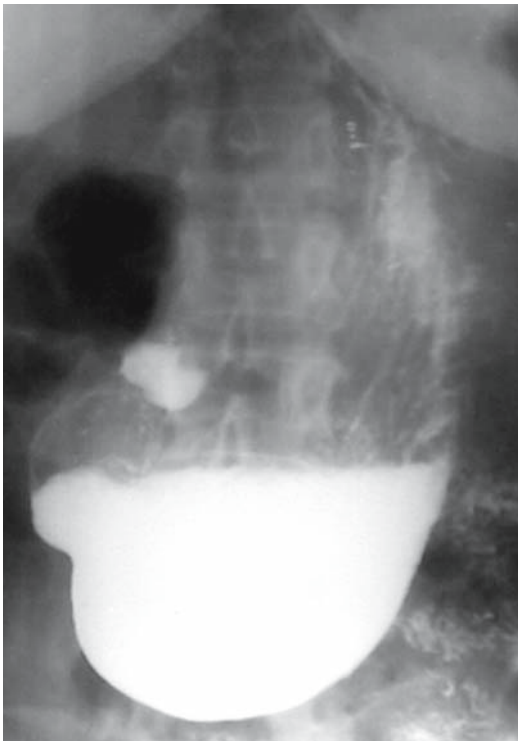
To summarize what has been said about distal gastric cancer, we should like to note once again some points in radiological diagnosis of the so-called pylorostenosis. Not infrequently, while planning a stomach resection for ulcer of the pyloroduodenal zone accompanied by severe evacuation dysfunction of the pylorus, the clinician still doubts the correctness of his decision because of the serious difficulties in preoperative establishment of the pathology. Serious deformational changes occurring with stenosis of the zone in question create special conditions for the traditional X-ray and endoscopic examinations. They considerably reduce the informative value of endoscopy, which is regarded as the final preoperative method of establishing the diagnosis. In such situations, the main responsibility should be shifted to radiological diagnosis, because much experience has been gained with it in revealing diffuse cancers, the prevailing oncological pathology in this zone [45, 73].

The entire systematized radiological semiotics of infiltrative cancers of the stomach is most closely connected with a special complex of methodological techniques aimed at the maximum imaging of intramural tumor process. This optimism is based on the possibility of currently used pneumographic and traditional components of gastroenterology to reveal thickening of the wall and its elasticity, which, in addition to evaluating the condition of the mucous membrane, effectively reveals tumor infiltration in this part of the stomach, which is the most difficult to access for an accurate diagnosis (Fig. 141). It follows, therefore, that, considering the importance of the final interpretation of the evacuation dysfunction of the pylorus, one must entertain the possibility of

radiological diagnosis of the so-called organic stenosis of the pyloroduodenal region [55].

It is time to revise the existing set of radiological signs which are still used not only by gastroenterologists and surgeons, but also by radiological diagnosticians, who choose not to deal with the diagnosis of early gastric cancer because they lack faith in the potentials of modern radiological diagnosis. This pertains first of all to the so-called residues of barium sulfate suspension that remain in the stomach for 24 h after the start of the X-ray examination. This must not be regarded as a sign of organic stenosis of the pyloroduodenal region. We have often observed cases in which primary examination of the stomach revealed all the signs believed to suggest organic stenosis of the pyloroduodenal region: boat-shaped ectatic stomach, which is found below the pectineal line, and significant residue of contrast medium after 24 h. Three to four weeks after conservative treatment, the stomach of such patients assumed a normal shape, while contrast medium was evacuated from the stomach even earlier (◘ Fig. 142). There are two aspects of major importance regarding the so-called organic stenosis of the stomach. The radiologist has to understand the cause of this stenosis (to be more exact, stable evacuation dysfunction of the pyloroduodenal region), whether it be a tumor with localization in the pylorus or the prepyloric part of the stomach, or a non-tumor pathology. This question can be answered with a traditional X-ray examination based on the polypositional principle, with tight filling of the stomach by a large amount of contrast medium, double contrast, and sometimes with air alone. If a small tumor is diagnosed, which causes stenosis owing to its specific location, the problem requires no further investigation. If a gastric tumor is ruled out, however, it is necessary to estimate very carefully the degree to which organic and functional components are involved. In any case, great care must be taken in interpreting the results of the examination. Of course, much depends on the clinical status of the patient. We have already expressed our negative attitude about the various pharmacological tests which are used to obtain more reliable information in these and other difficult differential-diagnosis situations. According to our data, this only adds to the difficulties of diagnosis, by masking the true picture. Our principle is a completely physiological X-ray examination of the stomach. Furthermore, pharmacological tests do not differentiate between functional disorder of evacuation and organic dysfunction. Only repeated X-ray examinations after one or several courses of treatment can lead to the final diagnosis. This is especially true for patients with gastroduodenal peptic ulcer, in whom stable evacuation dysfunction is due to edema and marked antral gastritis, symptoms that are relieved by prolonged adequate treatment. This position is confirmed by special studies conducted in Italy: Anti-Helicobacter therapy resulted in complete cure in 20 of 22 patients with diagnosed stenosis. In 17 patients signs of stenosis disappeared completely after 2 months and in three patients after 6 months. In other words, there was no actual organic stenosis, but rather a functional spasm of the pylorus in the presence of inflammatory changes. This confirms the important role of inflammatory and functional components of the »stenosis« picture, which is considered to be classical, and stresses the necessity of dynamic observation of such patients, including follow-up observation. With regard to evacuation dysfunction of the pyloroduodenal region, it is necessary to note that radiological diagnosis has obvious advantages over endoscopy for verifying the cause of so-called stenosis of this part of the stomach due to its specific anatomo-functional properties. In addition to data reported by the Italian researchers, our own observations of such patients confirm the need for substantial correction of the accepted set of signs characterizing so-called organic stenosis of the stomach.

◘ **Fig. 142 a–d.** Female patient Ya., age 54. Functional spasm of the pylorus. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): the antral part and the sinus of the stomach are ectatic, the stomach walls are even, evacuation function of the pylorus is disordered. **b** Stomach roentgenogram (tight filling, vertical position, anterior projection) in 24 h: residue of barium sulfate suspension is seen in the stomach cavity. Repeated endoscopy with biopsies failed to detect tumor cells. In the absence of signs of blastomatous affection, as evidenced by the main two instrumental methods, the patient was given conservative treatment. The same patient observed 3 weeks later. **c** Stomach roentgenogram (tight filling, vertical position, anterior projection): organic changes are not detectable, stomach contours are even, timely evacuation. **d** Stomach roentgenogram (tight filling, vertical position, anterior projection) in 24 h: the stomach is free of barium sulfate suspension, which is evenly distributed in the large intestine.



▲ Fig. 142 a.

▼ Fig. 142 b.

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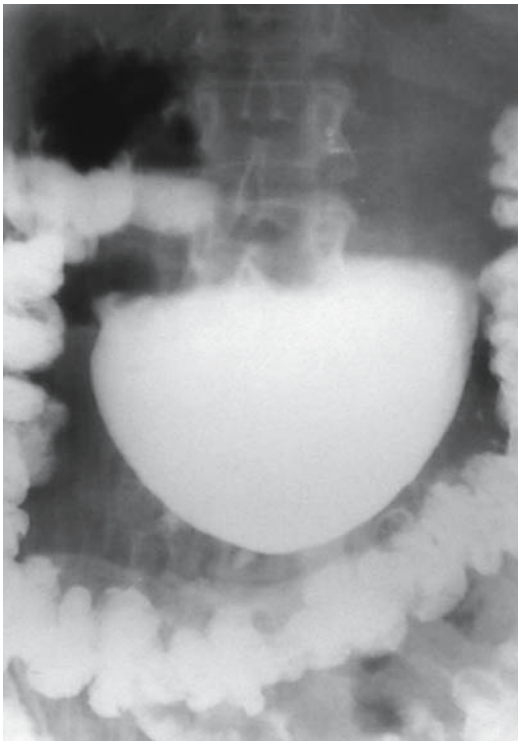
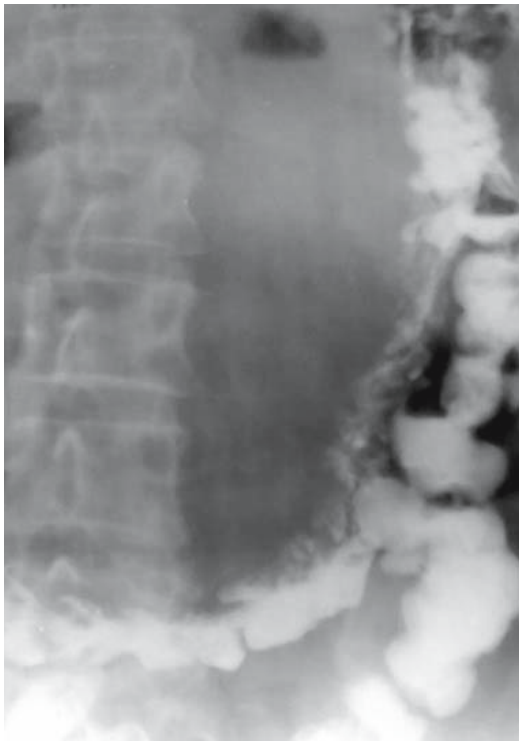


▼ Fig. 142 d.



Cancer of the Greater Curvature

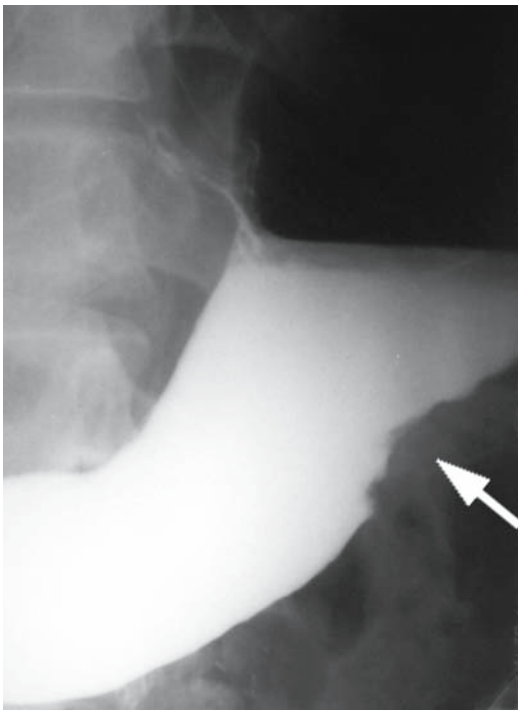
Until recently, the greater curvature was believed to be a rare localization of gastric cancer. For this reason, the literature contains only few reports on studies of tumors of the greater curvature. According to some authors, primary blastomatous affection of the greater curvature occurs in 1–3%, and they did not regard this pathology as an independent localization form. Other authors indicate a higher incidence of cancer of this localization (7.3–8.9%), but the results of screening demonstrate a much higher percentage of primary affection of the greater curvature.

Our experience in radiological diagnosis of gastric cancer shows that its primary localization on the greater curvature is much more frequent than reported by the authors who estimated it as 12.9% [41, 46, 99]. For several reasons – the main one being the absence of endoscopic confirmation – we observed patients with primary affection of the greater curvature for a year and longer. We found that the final stage of these tumors was endophytic fibrous carcinoma type infiltration of all walls of the stomach. This led us to conclude that a considerable portion of diffuse intramural cancers originate on the greater curvature. Thus, we think it necessary to discuss the diagnosis of tumors located on the greater curvature in more detail (◘ Fig. 143) [31, 34].

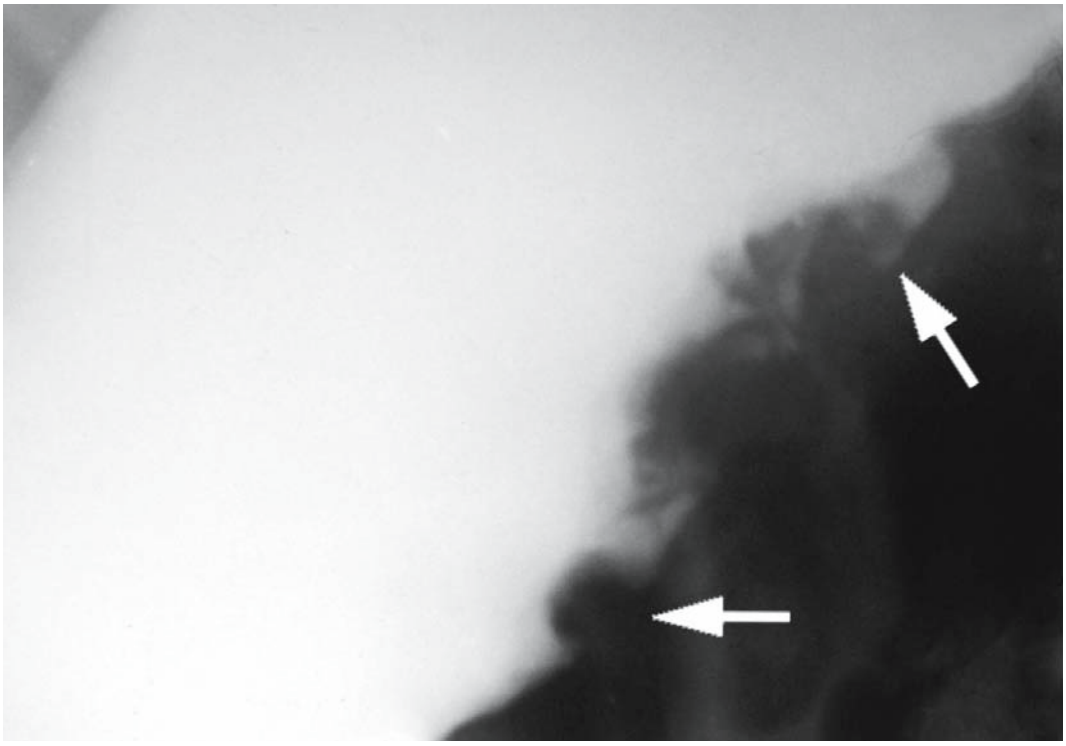
Owing to the specific anatomo-functional properties of the greater curvature, additional approaches to detecting the early signs of tumor are necessary. These approaches are not included in the existing standard methodology for reasons discussed in previous chapters. The standard methodology regards affections of the greater curvature in general, and tumors in particular, as a rarity. Most cancers originating on the greater curvature are not detected for the following two reasons: (a) the presence of pronounced mucosal folds, extending in a dorsal-ventral direction on the greater curvature, which respond to inflammatory disease and often do not stretch during X-ray and endoscopic examinations; (b) the absence of special additional techniques of examination [41].

The clinical picture of blastomatous affection of the greater curvature is not specific either. In most cases, cancer of this localization is characterized by an asymptomatic course, although some patients may complain of dull pain unassociated with meals and continuing for the greater part of the day. Other clinical symptoms, including loss of body weight, do not develop in all patients, and if they do, it is at later stages of the disease.

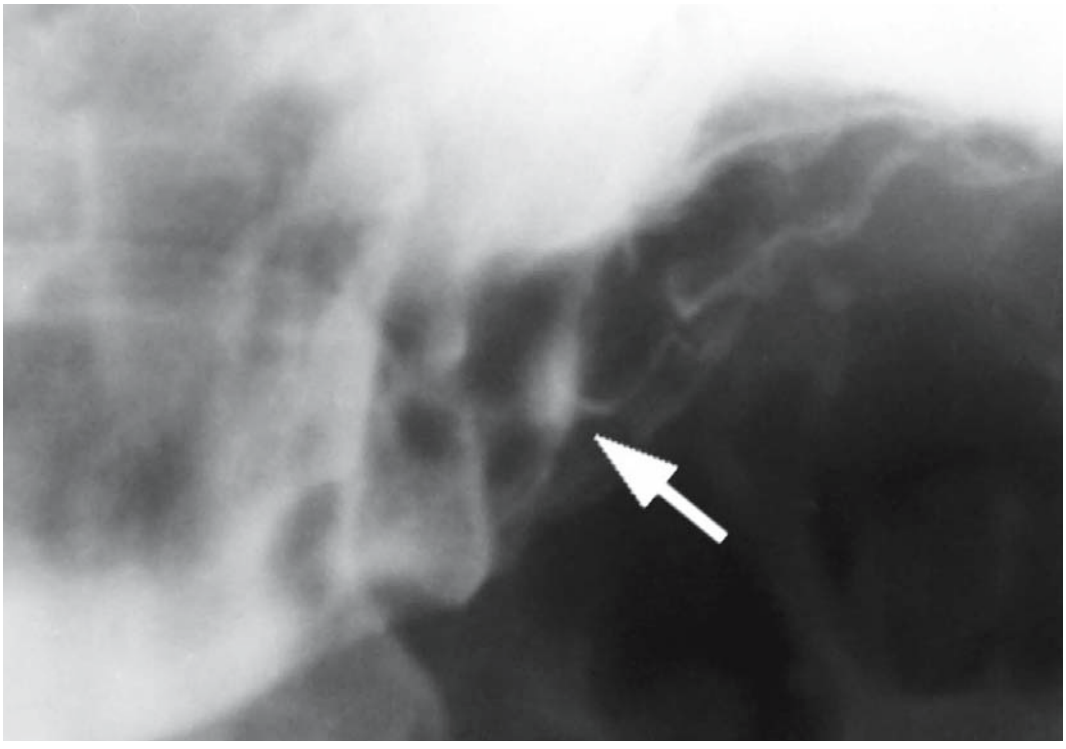
▼ **Fig. 143 a.**



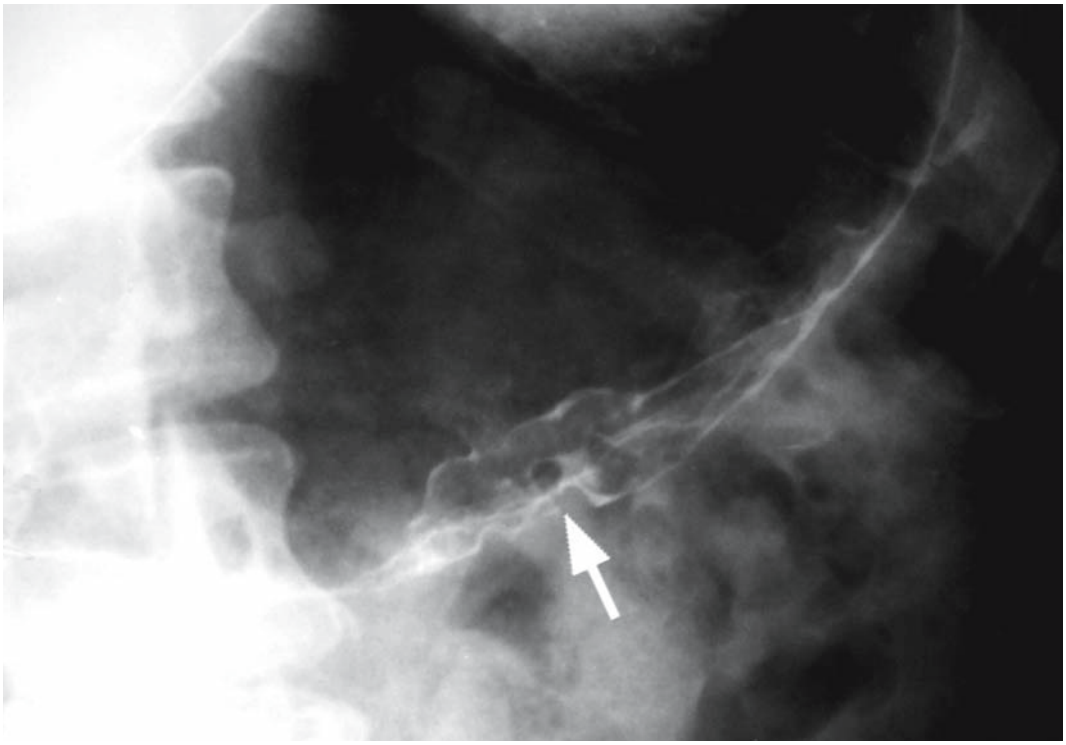
◘ **Fig. 143 a–e.** Patient I., age 55. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): uneven contour of the greater curvature (arrow). **b** Stomach roentgenogram (tight filling, vertical position, anterior projection), dosed compression: more distinctly visualized is the eroded contour of the greater curvature of the stomach body (arrows). **c** Stomach roentgenogram (tight filling, vertical position, anterior projection), dosed compression: intensified compression reveals a depot of contrast medium (arrow). **d** Stomach roentgenogram (double contrast, horizontal position, anterior projection): the wall of the greater curvature is thickened due to intramural infiltration; visualized at the center is a small rounded light image corresponding to an ulcer crater (arrow). Conclusion: Infiltrative-ulcerous cancer of the greater curvature of the stomach body. **e** Endophotograph: visualized in the region of the stomach sinus is a portion of mucous membrane, to 3 cm in diameter, which is slightly elevated over the surrounding tissues; the surface is rough, of grayish pink color, with flat linear ulceration at the center. Histological examination of the bioptates verified non-differentiated cancer.



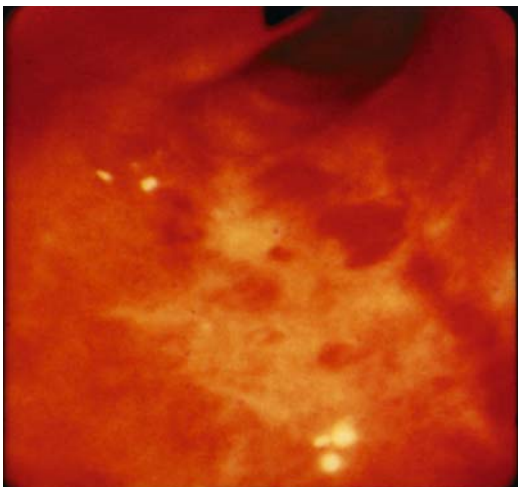
▲ Fig. 143 b.



▼ Fig. 143 c.



▲ Fig. 143 d.



▼ Fig. 143 e.

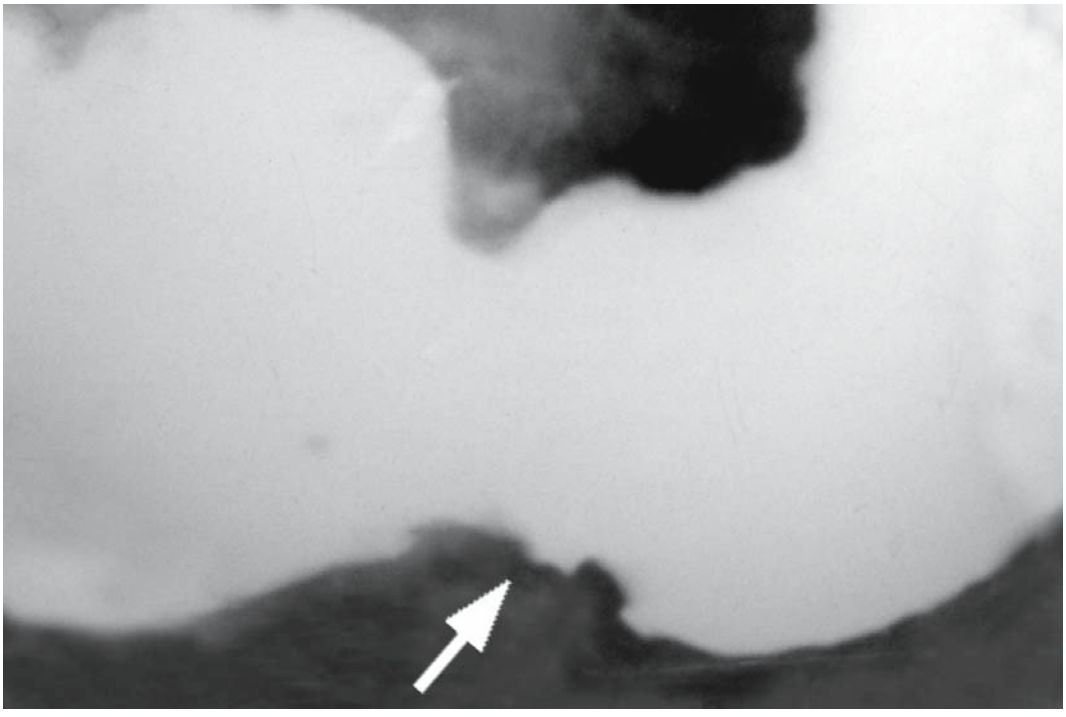
Malignant tumors of the linitis plastica and scirrhous type are usually characterized by the absence of a pronounced clinical picture. Even more difficult is clinical diagnosis of primary lesions in the »dumb« zone of the greater curvature of the stomach, in its upper third, where, according to H. Fukotomi and T. Sakita (1984), infiltration of the wall may be of significant thickness whereas its function may be relatively normal. At the same time, these authors indicate a high incidence of cancer of the greater curvature of the lower third of the stomach body. The number of tumors at this site exceeds that of tumors on the lesser curvature, the anterior wall, and posterior wall taken together. In our observations, this part of the stomach was affected in 57.6% of all cancer cases, the primary location of which was the greater curvature, and as a rule, additional methodological efforts were necessary for thorough study. As we have already noted, blastomatous infiltration often spreads to the higher parts, and eventually results in the classical linitis plastica type diffuse affection of the stomach. The necessity of improving the diagnosis of tumors of the greater curvature becomes even more apparent if we remember that the results of surgery for cancer of this localization are somewhat better compared with cancers of other localizations. This was true in cases of early detected infiltrative tumors, a considerable percentage of which were located primarily in the stomach body in the region of the greater curvature. In our opin-

ion, the solution here is to screen risk groups for gastric cancer (some authors call them asymptomatic subjects) [8, 57, 73].

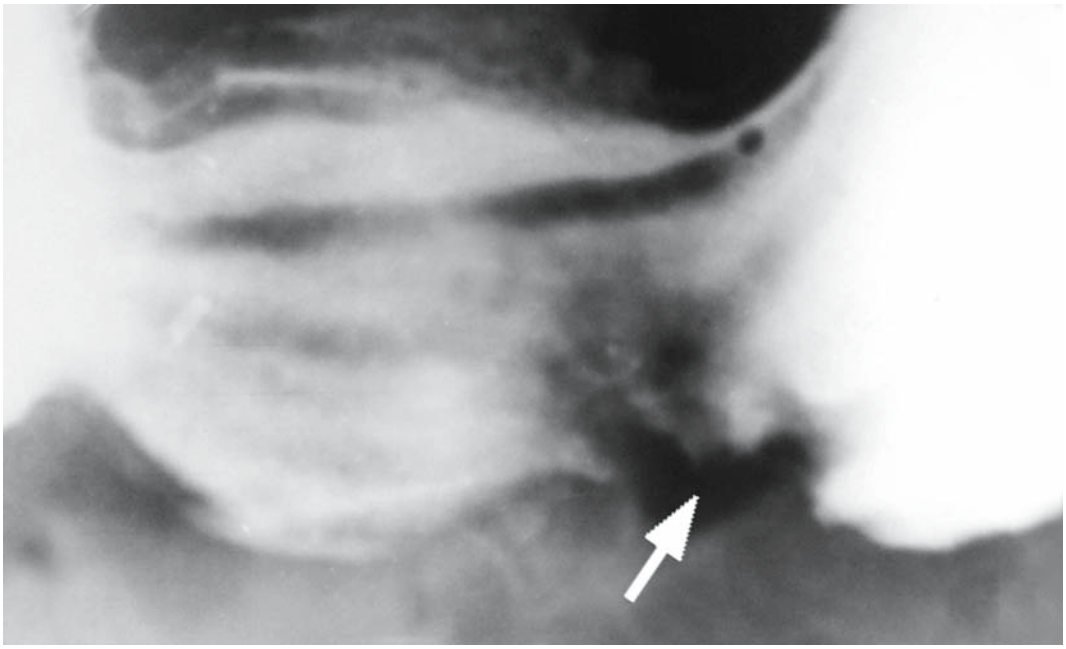
Unfortunately, in spite of numerous publications stressing the importance of a complex use of radiological methods in combination with fibergastroscopy (with biopsy) to detect cancer of the greater curvature, many clinicians continue to depend on endoscopy alone. Meanwhile, practical experience shows that routine endoscopy with the traditional technique of taking tissue specimens, has less informative value in such cancers than in those at other locations. The mucosal relief of the greater curvature is so rich that it is very difficult to reveal minor changes in this part of the stomach, the more so if the submucous coat is involved.

The X-ray examination aimed at early diagnosis of new growths in this part of the stomach consists in a thorough study of a series of target X-rays imaging not only the mucosal relief but also the contour of the greater curvature during tighter filling of the stomach with barium sulfate suspension. The study at the phase of tight filling is mandatory. To this end, the patient has to ingest an additional portion of barium sulfate suspension (Fig. 144) [36, 41, 54].

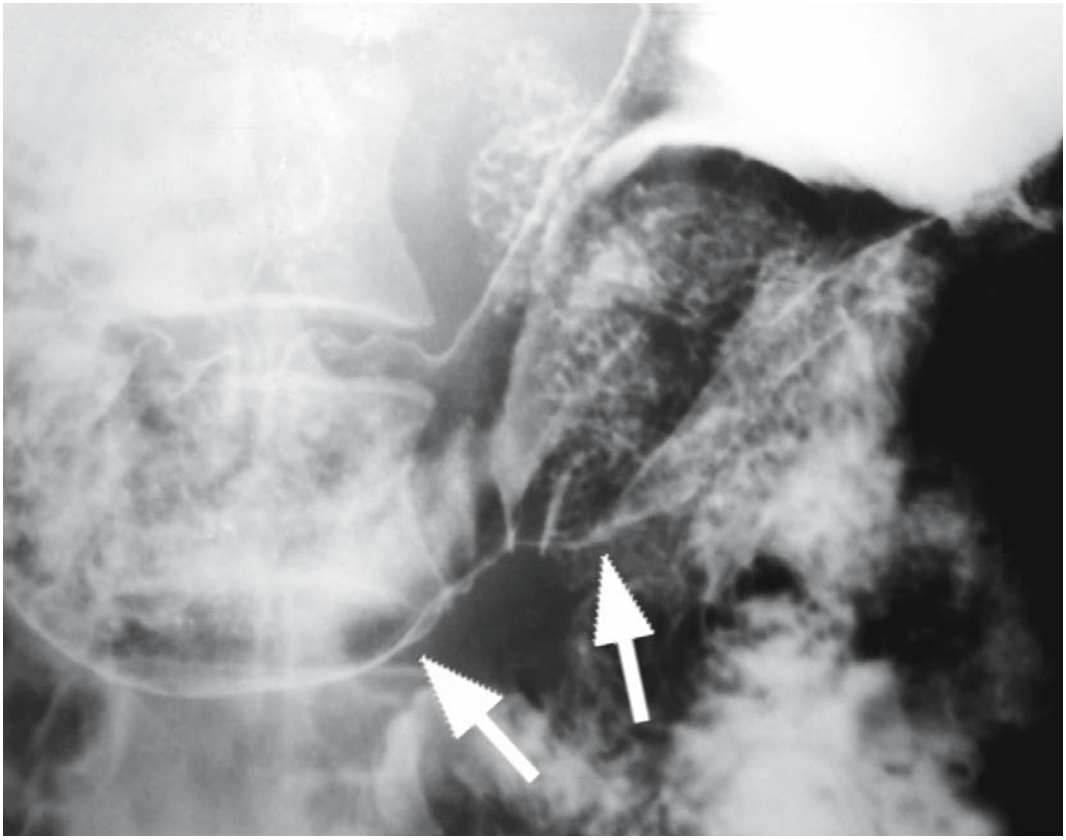
▲ **Fig. 144 a.**



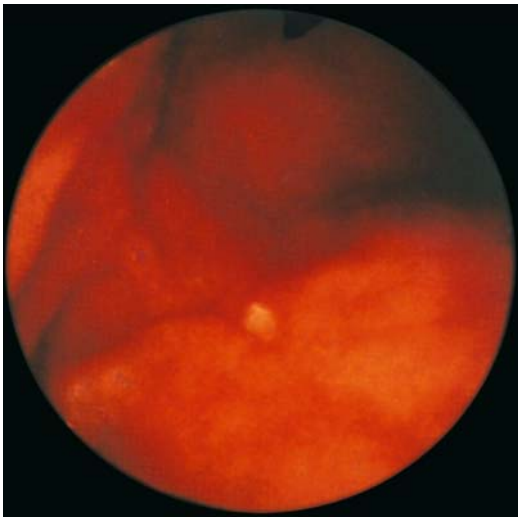
▼ **Fig. 144 b.**



▲ **Fig. 144 c.**



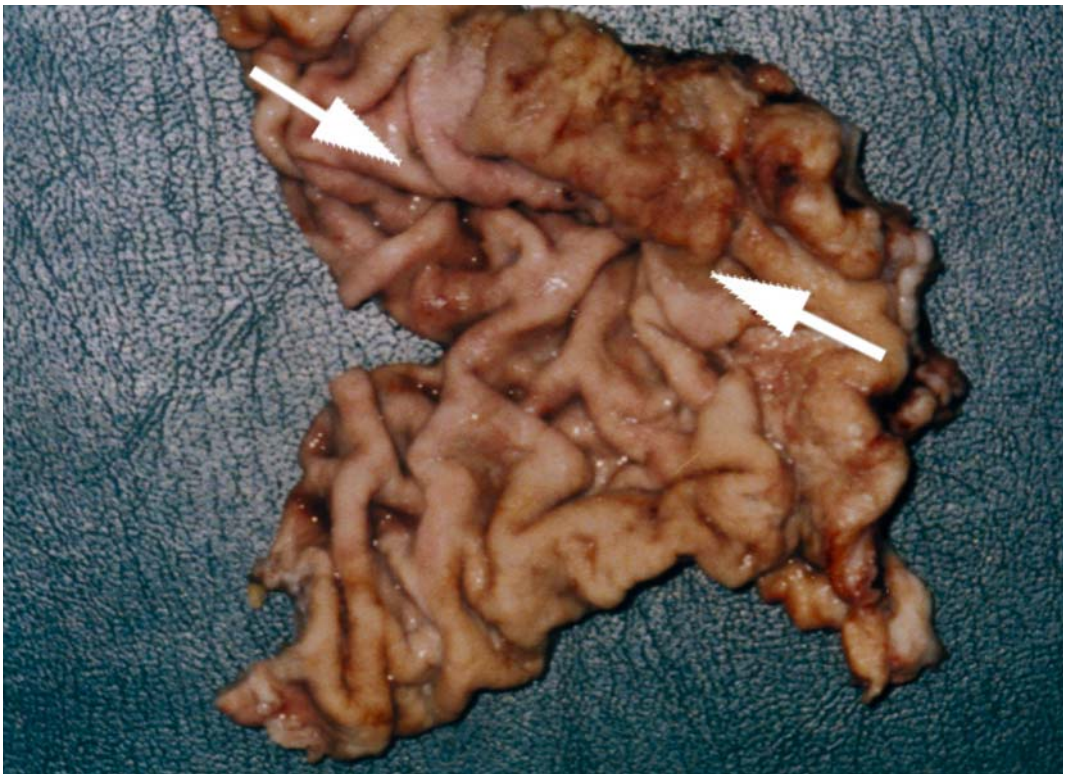
▼ **Fig. 144 d.**

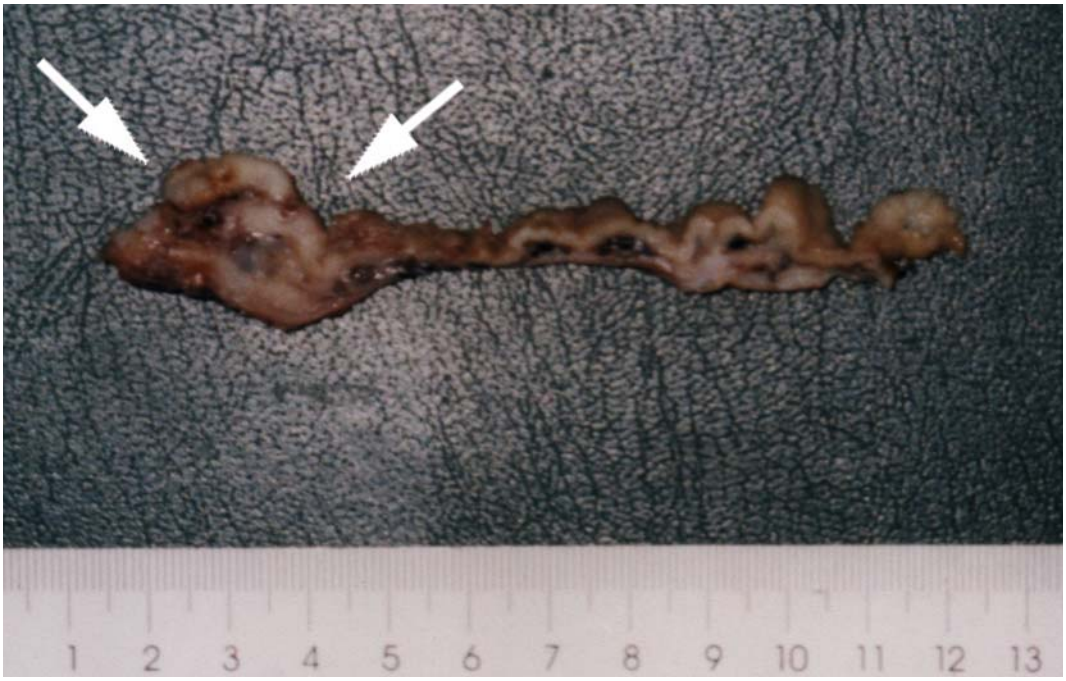


▲ **Fig. 144 e.**

Fig. 144 a–g. Female patient V., age 48. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): on the greater curvature in the proximal portion of the antral part visualized is a small portion of an uneven contour, which is slightly depressed into the stomach cavity (arrow); peristalsis is seen over the entire length. **b, c** Stomach roentgenograms (tight filling, vertical position, anterior projection), dosed compression: a site of infiltration with a centrally located niche of irregular rounded shape within confinements of the stomach contours (corresponding to the revealed changes) is seen (arrows). **d** Stomach roentgenogram (double contrast, horizontal position, anterior projection): a portion of infiltrated wall is seen on the greater curvature of the proximal part of the antral part with folds converging towards infiltration (arrows). Conclusion: Infiltrative-ulcerous cancer of the greater curvature of the antral part of the stomach. **e** Endophotograph: a portion of the mucous membrane of grayish pink color, with a rough surface, slightly elevated over the surrounding tissues is seen in the sinus of the stomach on its greater curvature; folds of mucous membrane converge toward the margins of this portion; ulceration sized 0.4 x 0.3 x 0.1 cm is seen at the center of infiltration; its margins are scarlet, the floor is covered with a fibrin coat. Histological examinations of the bioptates verified non-differentiated cancer. **f** Macrospecimen of the resected stomach: the wall of the greater curvature is firm; a portion of the intramural infiltration with folds converging towards it is visualized (arrows). **g** Fragment of the macrospecimen (strip): the stomach wall is thickened due to intramural infiltration (arrows).

▼ **Fig. 144 f.**





▲ Fig. 144 g.

▼ Fig. 145 a.

▼ Fig. 145 b.

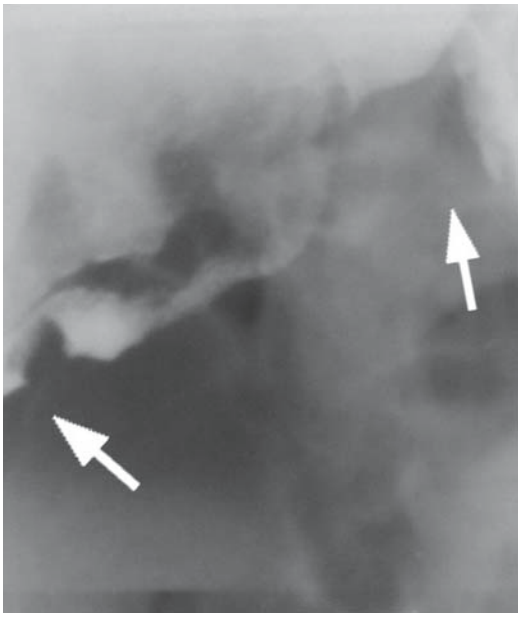
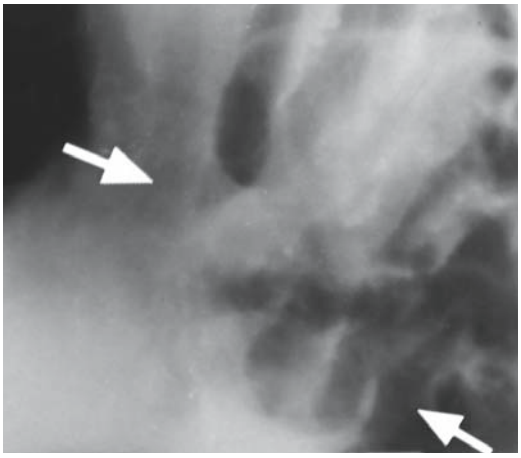
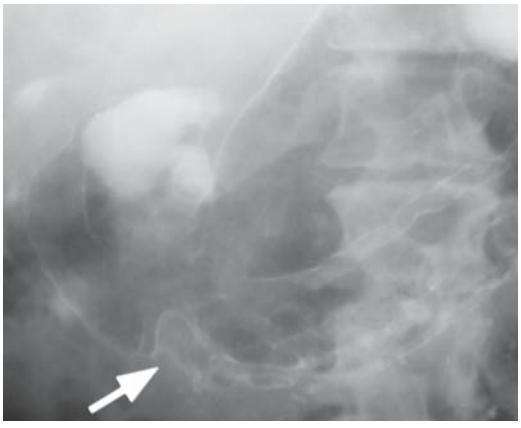


Fig. 145 a–d. Patient A., age 61. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, right anterior quarter-oblique projection): uneven contour of the greater curvature of the sinus (arrow). **b, c** Stomach roentgenograms (tight filling, vertical position, left half-oblique projection), dosed compression: folds converge toward the infiltration on the greater curvature (arrows). **d** Stomach roentgenogram (double contrast, horizontal position, anterior projection): a portion of infiltrated wall on the greater curvature of the sinus with thickened folds converging toward this portion (arrow). Conclusion: Infiltrative cancer of the greater curvature of the stomach sinus. The patient was operated. Histologically, signet-ring cell carcinoma.

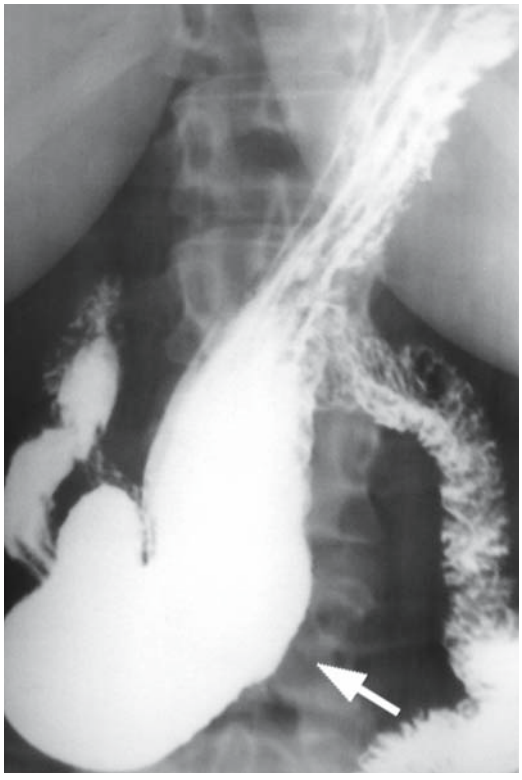


▲ Fig. 145 c.



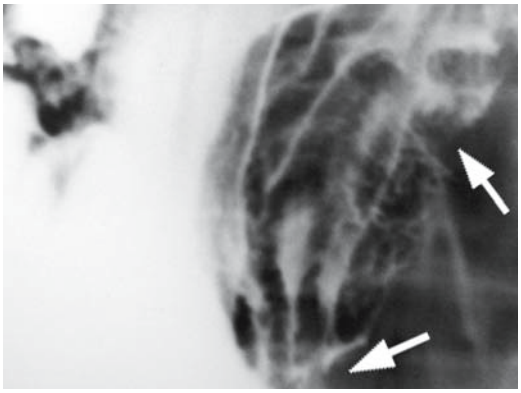
▼ Fig. 145 d.

The double-contrast investigation is of special importance. It helps to assess not only the condition of the mucous membrane but also the stomach wall thickness. The method is universal, because in addition to visualizing organic changes it also helps to detect functional disorders, which are manifested by decreasing elasticity of the infiltrated stomach wall. Quantitative information obtained by this method exceeds the findings of any other modification of classical methods of examination without double contrast. Neither the presence of peristaltic activity nor the absence of deformation of the relief can today confirm the absence of endophytic gastric cancer. Diffuse cancers of the greater curvature are the main difficulty in classical roentgenology; at the same time, this is a field where the informative value of X-ray studies is not worse than that of fibergastroscopy (◘ Fig. 145).

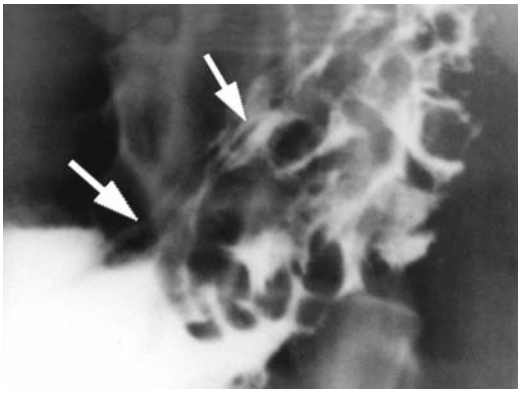


▲ Fig. 146 a.

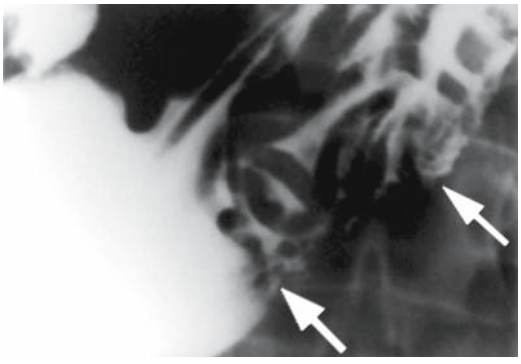
◘ **Fig. 146 a–g.** Female patient Ch., age 42. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, left anterior quarter-oblique projection): uneven contours of greater curvature on lower third of stomach body (arrow). **b, c, d, e** Stomach roentgenograms (tight filling, vertical position, left half-oblique projection), dosed compression: visualized at different degrees of compression is a depot of contrast medium with infiltration ridge and folds converging toward it (terminating at the periphery) on the greater curvature in lower third of stomach body (arrows). Conclusion: Infiltrative-ulcerous cancer of the greater curvature of the lower third of the stomach body. Endoscopy with subsequent histological examination of bioptates failed to reveal tumor affection. The patient was examined by MRI of the stomach. **f** MR image of the stomach (coronary projection in conditions of tight filling of the stomach cavity with water, T2 SSFSE): uneven contour of the greater curvature in the lower third of the stomach body (arrow). **g** MR image (coronary projection, tight filling of the stomach with water, FSPGR out of phase): uneven contour of the greater curvature in the lower third of the stomach body. The wall is thickened over a distance of 28 mm, heterogeneous MR signal (arrows). The serous membrane is seen at all levels, including the site of wall thickening. Conclusion: Infiltrative-ulcerous cancer of the greater curvature in the lower third of the stomach body without involvement of the serous coat of the stomach wall. The patient was operated. Histologically, non-differentiated cancer.



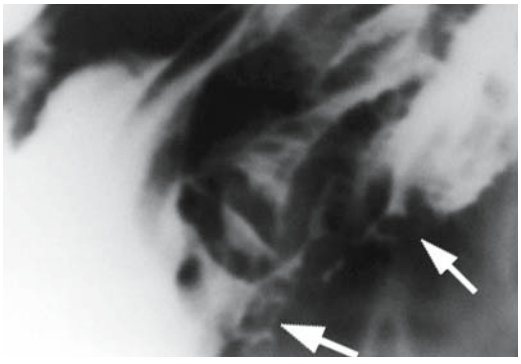
▲ Fig. 146 b.



▲ Fig. 146 d.



▼ Fig. 146 c.



▼ Fig. 146 e.

In some of our observations, the double-contrast investigation proved to be the only effective tool to diagnose cancer of the greater curvature at its initial stage. Another field of application of this method is target endoscopy, during which tissue specimens are taken from the zone where X-ray examination has suspected the presence of a tumor. Bioptates are taken using instruments (aspiration, needle, »hot« biopsy, etc.) specially designed for taking tissue specimens from the submucous coat. But G. Caletti et al. (1989) indicate that these methods often prove ineffective. Verification of the site for taking tissue specimens by staining the mucous membrane of the stomach affected by superficially growing tumor, which is effective in 95–97% of cases, becomes infeasible with submucous spread of the tumor [24]. X-ray findings become decisive in such cases.

Close cooperation between a radiological diagnostician and an endoscopist is the guarantee of successful detection of gastric cancer. Japanese researchers united radiology and endoscopy in a single program for examination of risk groups for gastric cancer, based on standardized semiotics, methodology, and surgical treatment, to attain unprecedented success in diagnosis and treatment.

Ulcerated tumors occur mostly on the greater curvature. Although they are possible to diagnose at present, they nevertheless remain a serious problem in gastroentero-ocology. Difficulties that arise in revealing tumor substrate on the greater curvature add to the problems of differentiating between benign and malignant ulcerations. Additional problems arise with signs which are not characteristic of typical cancer ulcers. Either they are difficult to identify or they resemble common peptic ulcer. X-ray examinations in such cases revealed depression on the contour and a niche (as distinct from blastomatous ulceration of the lesser curvature, which extends beyond the limits of the stomach contour in rare cases). The ridge of infiltrated tissue is more pronounced; the folds may converge not toward the ulcerated site but toward the infiltration ridge (◘ Fig. 146) [46].

▲ Fig. 146 f.

▼ Fig. 146 g.

Specific ulceration of the greater curvature and differential diagnosis became the subject of concern of oncologists early in the twentieth century, at the dawn of roentgenology. Holmes and Hempton (1932) concluded from their observations that all ulcers of this localization require surgery. Smith and Jordan (1948) strengthened the opinion that ulcers on the greater curvature are malignant in 60% cases. Bourdeau et al. (1951) and McClone and Robertson (1953) revealed malignant ulceration of the greater curvature in 49–56% of all ulcers of the stomach. This concern of the specialists was shared by radiologists.

In the 1950s and 1960s, many publications dealt with the problem of X-ray diagnosis of malignant and benign ulcers of the greater curvature. They all reflected the inability of classical radiology, based on the traditional method of tight filling, to establish definite criteria for differential diagnosis of these conditions. Signs of malignant ulcers (convergence of mucosal folds toward the ulcer, their termination at the infiltration ridge, location of the niche within the confinements of the stomach contours, etc.), which are more characteristic of pathologies of the lesser curvature, are often useless in conditions affecting the anatomical and functional properties of the greater curvature.

We want to explain our opinion on infiltrative cancer of the greater curvature based on the results of studies using traditional methods and the double-contrast technique with obligatory endoscopy as an additional tool of examining the abdominal cavity and the stomach (in recent years we have also used ultrasonogrpaphy, CT, or MRI). Our experience shows that a methodologically correct examination can reveal some signs that are quite specific for infiltrative-ulcerous cancer. The most important of these, which help to establish the radiological diagnosis, are the following: irregular shapes of the ulcer crater with overhanging and eroded contours, walls thickened to various degrees and to various lengths, upset peristalsis, and elasticity of the stomach walls.

We want to note again that with discovery of any ulcer of the stomach, and especially on its greater curvature, the main objective of the radiological diagnostician is to rule out blastomatous infiltration. Even with dynamic observation during treatment of the patient, in cases where endoscopic signs of ulceration disappear, only the stability of intramural changes helps the physician to avoid fatal diagnostic errors.

The greater curvature is more frequently affected by blastomatous process of mostly diffuse character than was believed in the 1990s. Therefore, discovery of signs of cancer infiltration at this localization must suggest the use of »extreme« technologies: ingestion of greater amounts of contrast medium, maximum permissible inflation of the

stomach. These measures give more accurate information on the presence or absence of infiltrative cancer of the greater curvature of the stomach with or without ulceration.

To conclude this section, it is necessary to note that, like cancer of the anterior wall, cancer of the greater curvature has many »latent« aspects which should be considered today by both diagnosticians and clinicians. First and foremost is the considerably greater percentage of endophytic (diffuse) cancers at their early stages, and also the important role of updated means of radiological diagnosis such as ultrasonography, CT, and MRI in their detection.

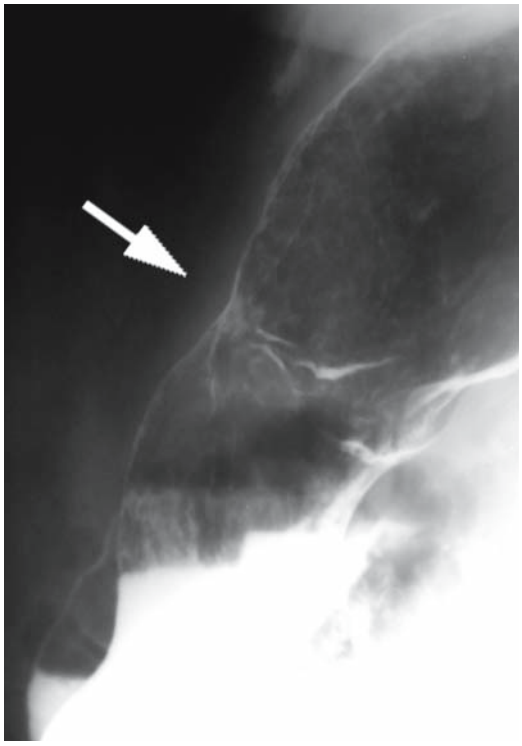
Cancer of the Anterior Wall

Even today popular opinion holds that cancer of the anterior wall is an extremely rare incidence. In supporting of this point of view, allusion is made to the absence of statistical data on the frequency of new growths at this localization in the great majority of publications. Based on our experience, we do not agree with this opinion. The more so that some other authors have the same view of this problem as ours (T. Hirota et al. 1984; W. Meyer et al. 1987). They indicate the tendency to an increasing proportion of cancers of the anterior wall. D. Brandt et al. (1989) state that the percentage of cancer of the anterior wall in the antral part of the stomach is the same as that of tumors located on the posterior wall in this part of the stomach. Our opinion on this problem coincides with that of researchers who believe that the anterior wall is the site where gastric cancer occurs more frequently than is believed by many authors. But diagnosis of new growths at this localization is difficult because their possibility is underestimated. Cancer of the anterior wall does not show clinically until evacuation dysfunction of the stomach or of the esophagus develops due to severe circular narrowing of the organ. This usually happens in patients with far advanced cancer when it is no longer possible to locate the primary site of the tumor. Screening programs developed in Japan make it possible to significantly improve detection of primary cancers of the anterior wall. This stimulated researchers in other countries to take a new look at the problem [143, 239]. Our research also confirms this standpoint [31, 34, 223, 224].

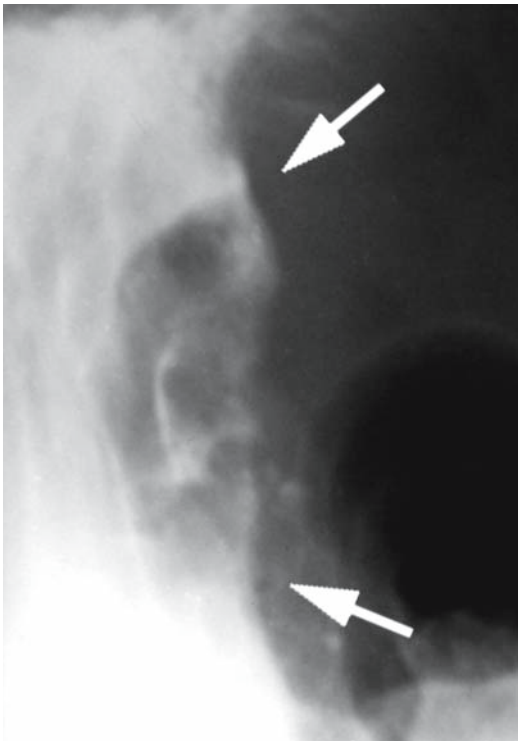
The special methodological approach to diagnosis of cancer of the anterior wall consists in special projections for this region of the stomach body and its antral part, and in using additional techniques such as »mild and incomplete« compression under fluoroscopy guidance (◘ Fig. 147). The non-standard nature of anterior wall imaging made roentgenologists pay special attention to the examination procedure itself. This involved changes in methodology. Thus, Hisamichi et al. [144] recommended that the patient ingest the first portions of barium sulfate suspension in the prone position, which gives unexpected results. Roentgenological screening conducted by this method revealed a markedly increased incidence of early cancers of the anterior wall of the stomach [142, 143].

▼ **Fig. 147 a.**

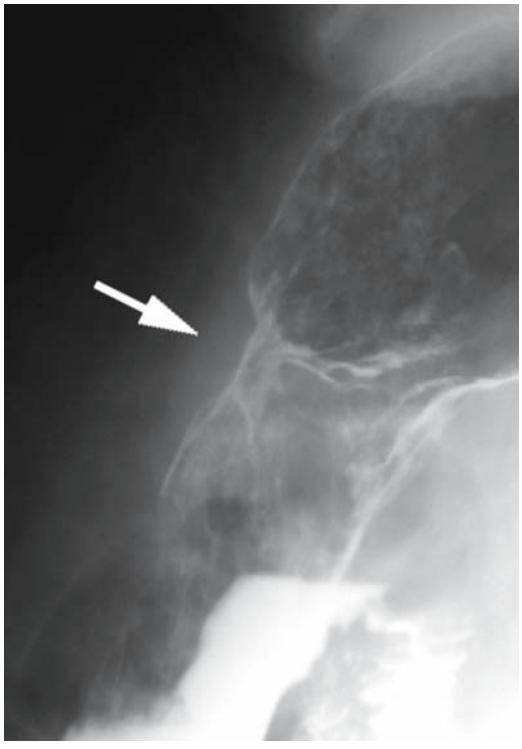
▲ Fig. 147 b.



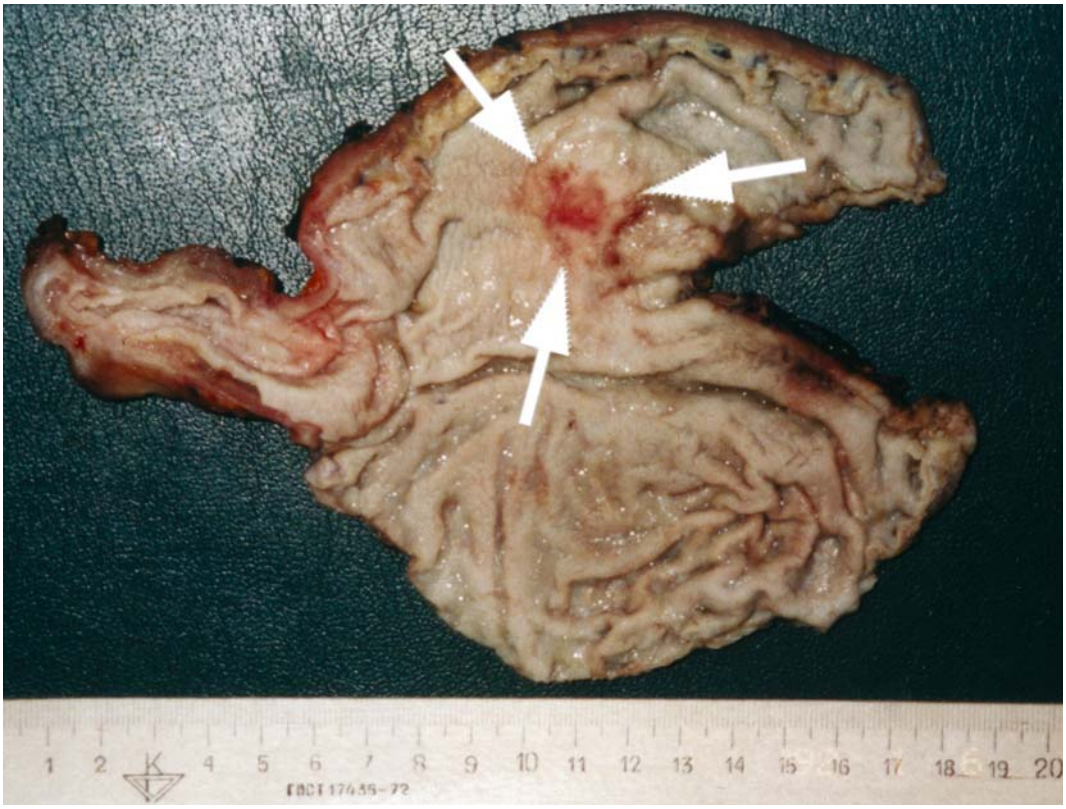
▲ Fig. 147 d.



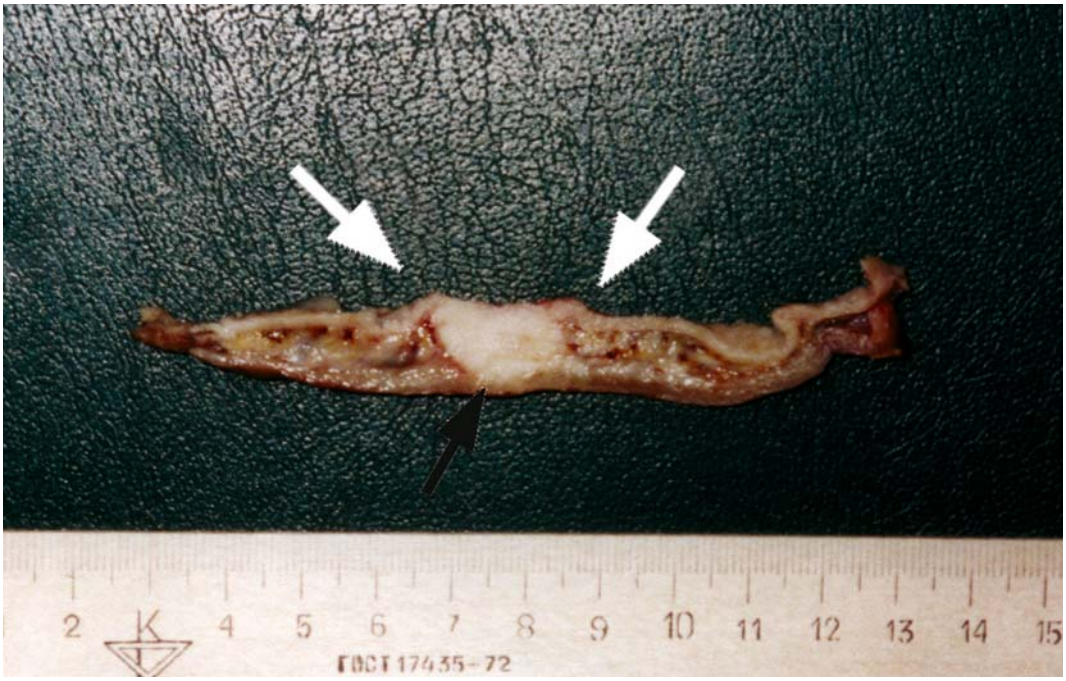
▼ Fig. 147 c.



▼ Fig. 147 e.



▲ Fig. 147 f.



▼ Fig. 147 g.

Fig. 147 a–g. Female patient A., age 56. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): organic changes are not detectable. **b, c** Stomach roentgenograms (tight filling, vertical position, left half-oblique projection), dosed compression: slight compression visualizes a depot of contrast medium on the anterior wall of the stomach body in the form of a spider surrounded by a ridge of infiltrated tissue with folds terminating at the periphery (arrows). **d** Stomach roentgenogram (double contrast, vertical position, left anterior oblique projection): the anterior wall of the upper third of the stomach body is thickened due to intramural infiltration (arrow); the folds converge toward the affected site. **e** Stomach roentgenogram (double contrast, vertical position, left lateral projection): with optimal projection, more distinctly visualized is thickening of the anterior wall of the upper third of the stomach body due to intramural infiltration (arrow) and the folds converging toward the involved part. Conclusion: Infiltrative-ulcerous cancer of the anterior wall of the upper third of the stomach body. **f** Macrospecimen of the resected stomach: ulceration with an atypical relief is seen on the anterior wall (arrows). **g** Fragment of the macrospecimen (strip): the stomach wall is thickened due to white intramural infiltration of mostly mucous and submucous coats (white arrows); initial invasion of the muscular coat (black arrow). Histologically, signet-ring cell carcinoma.

The complexity of the skiagram suggested the necessity of searching for optimal approaches to the diagnosis of cancer at this location. Some authors proposed special projections and techniques. The following seem to be the most important:

1. Left anterior oblique projection, more suitable for visualization of the pyloric ring
2. Left lateral projection
3. Posterior straight or left oblique projection in the horizontal position

In our practical work, we usually use the following techniques. Where it is necessary to examine the anterior wall of the antral part, we use tight filling of the stomach with a slightly excessive amount of barium sulfate suspension and turn the patient to the left lateral projection, taking a series of X-ray pictures under compression. The anterior wall of the stomach body is easy to image using one of the standard projections: left lateral projection in the vertical or horizontal position, both with tight filling and double contrast (Fig. 148).

With special emphasis on the diagnosis of cancer with its primary location on the anterior wall, we want to note once again how updated technical facilities can change our concept of the pathology under discussion. Information adequate for the preoperative establishment of diagnosis can be obtained only in cases where the methodology agrees with the technical components of the diagnostic process. As applied to infiltrative cancers located on the anterior wall, we want to discuss some problems we have encountered in our practical experience. We have observed situations in which such tumors spread to more vulnerable anatomical structures, such as the lesser curvature and the greater curvature of the stomach. Minor changes, often called partial changes on the contour, suggested early or minor cancer. But the projections used specifically for visualization of the anterior wall not only removed any doubt of the tumor, but also verified its primary location on the anterior wall. [28, 223].

Using the necessary additional methods, which differ depending on the location of the tumor in the stomach body or its antral part, we obtained quite specific signs of tumor infiltration. These included local thickening of the wall over short distances with converging folds, which produce an indistinct stellar pattern, or certain contraction, and asymmetry of mucosal relief. The signs detectable with double-contrast radiology are supplemented by the traditional signs of uneven contours in the presence of tight filling and disfiguring changes which become apparent with compression of the involved part of the stomach, if the tumor is found in the lower third of the stomach body and its antral part.

By filling the stomach with a slightly greater portion of barium sulfate suspension at the phase of tight filling and applying the minimal possible compression, it is possible to visualize such signs of early cancer of the anterior wall as spiders (under 0.6–0.8 cm) against the background of the relief of the anterior wall of the stomach (▶ Fig. 55). When dosed compression is applied in such situations, it is possible to see at this level a distinct (limited to 1 cm) thickening of the wall with one or two folds terminating at this level.

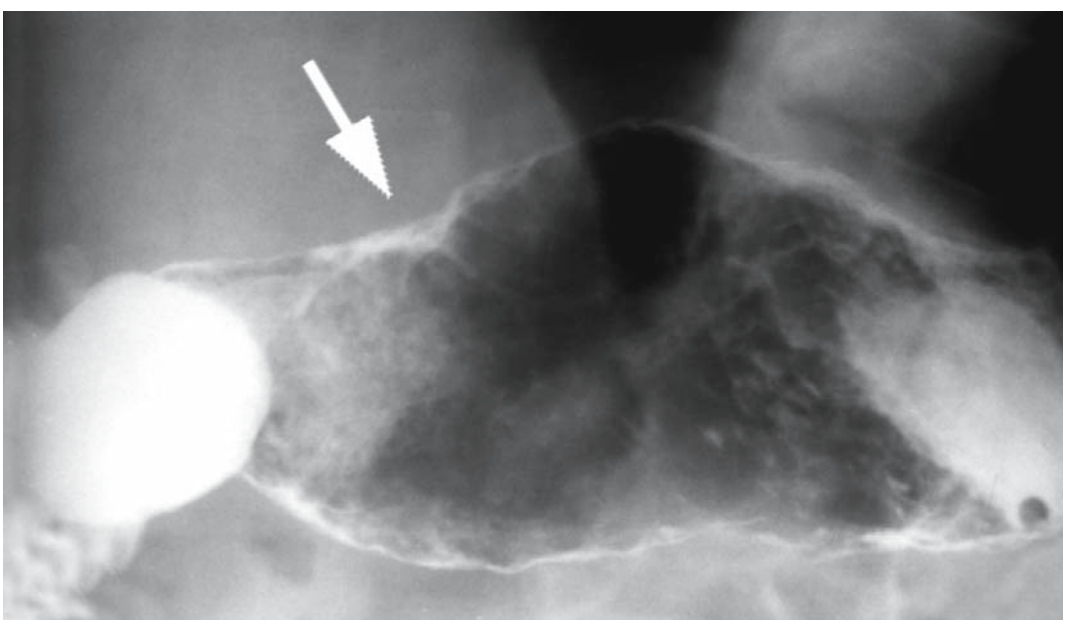
In other words, tight filling of the stomach with the above mentioned additional meals and dosed compression form a special complex in current radiological diagnosis which can reveal early manifestation of gastric cancer. This becomes feasible if the physician remembers that roentgenogastroenterology can give important results in diagnosis of gastric cancer, and if the radiologist disposes of sufficient knowledge and skills in using the methods and fundamental signs.

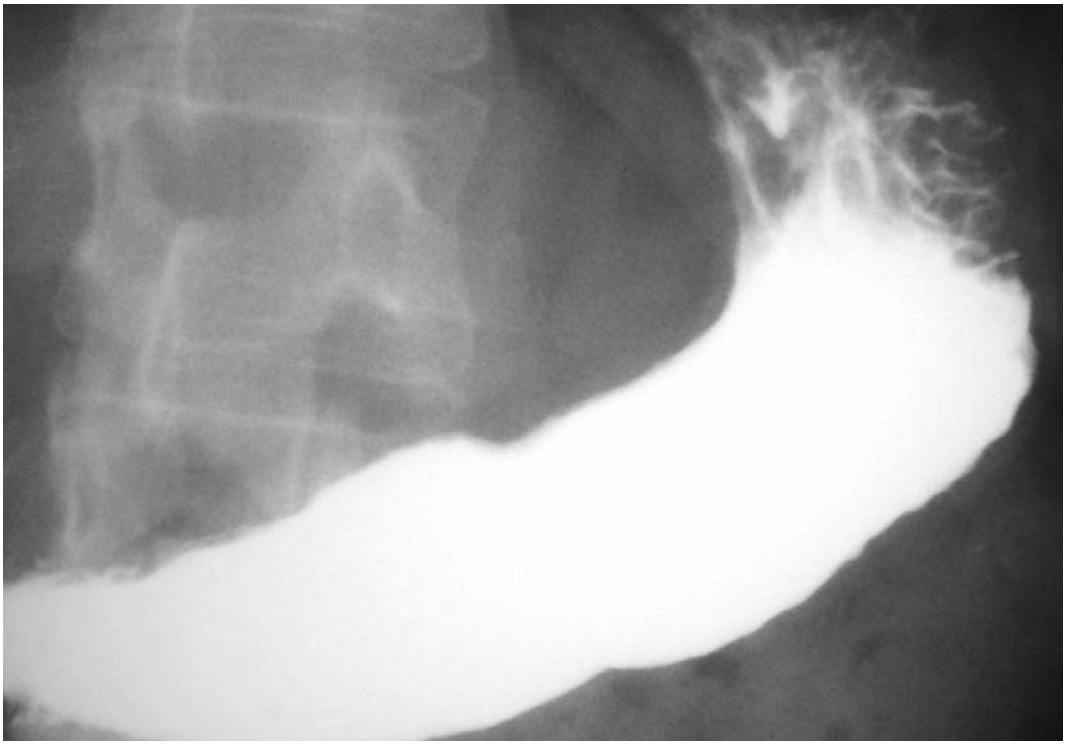
▲ **Fig. 148 a.**

Fig. 148 a, b. Patient D., age 62. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): organic changes are not detectable. **b** Stomach roentgenogram (double contrast, horizontal position, left lateral projection): the anterior wall of the lower third of the stomach body is thickened due to intramural infiltration with folds converging toward it (arrow). Conclusion: Minor infiltrative cancer of the anterior wall of the lower third of the stomach body. The patient was operated. Histologically, adenocarcinoma with the signet-ring cell component.

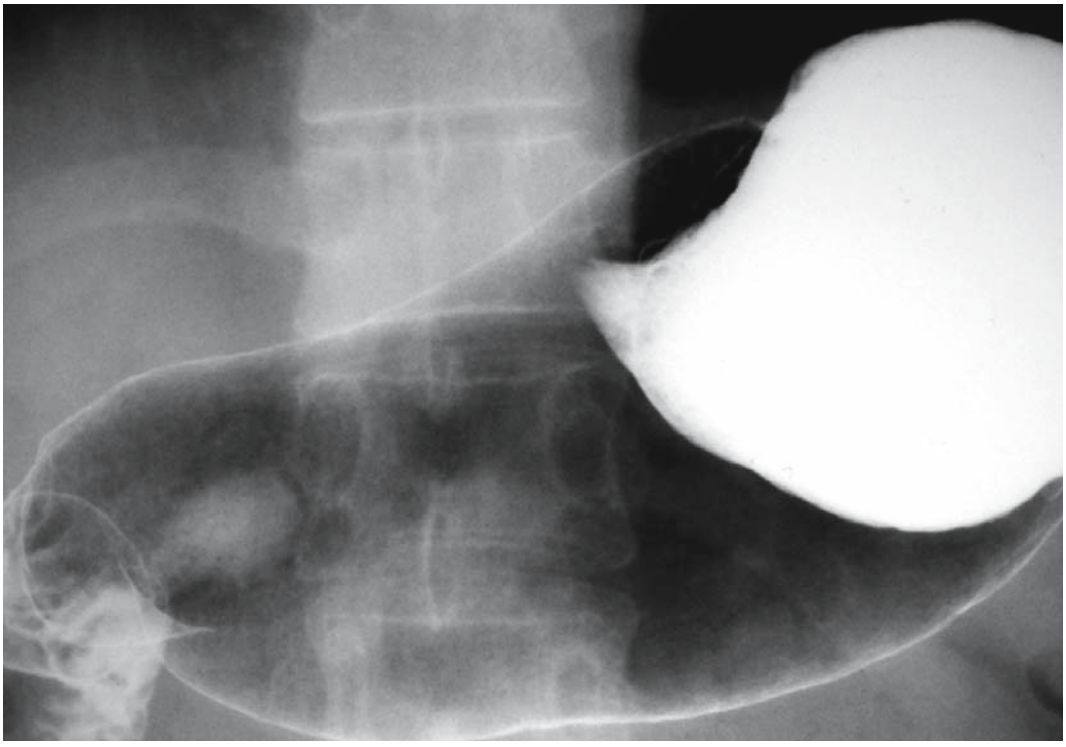
Fig. 149 a–d. Female patient S., age 56. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection): horn-shaped stomach. **b** Stomach roentgenogram (double contrast, horizontal position, anterior projection): no organic changes are found; stomach walls are elastic and of normal thickness. **c** Stomach roentgenogram (double contrast, horizontal position, left lateral projection): anterior wall of upper third of the stomach is thickened (arrow). **d** Stomach roentgenogram (double contrast, vertical position, left lateral projection): anterior wall of upper third of the stomach body is thickened due to intramural infiltration with the folds converging toward it (arrow). Conclusion: Minor infiltrative cancer of the anterior wall of the stomach body. The patient was operated. Histologically, signet-ring cell carcinoma.

▼ **Fig. 148 b.**

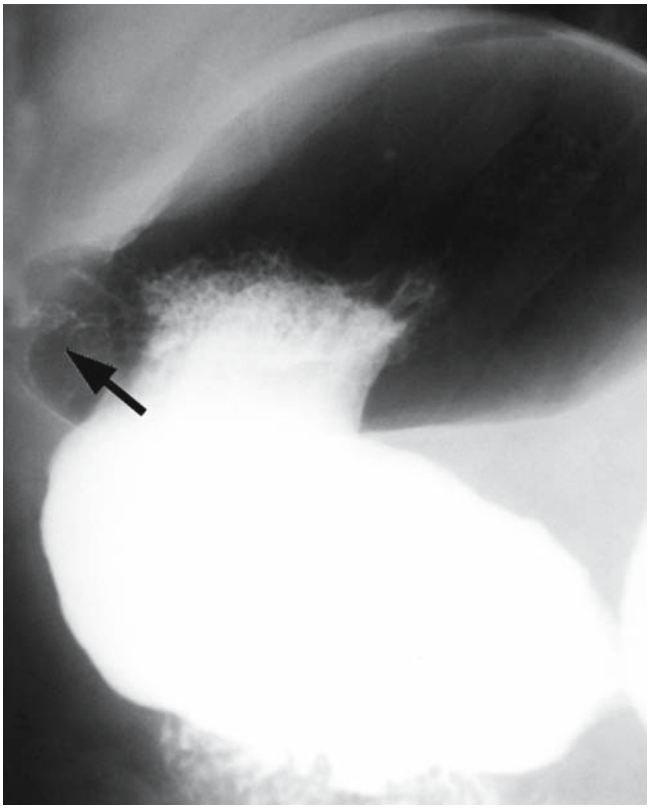




▲ Fig. 149 a.



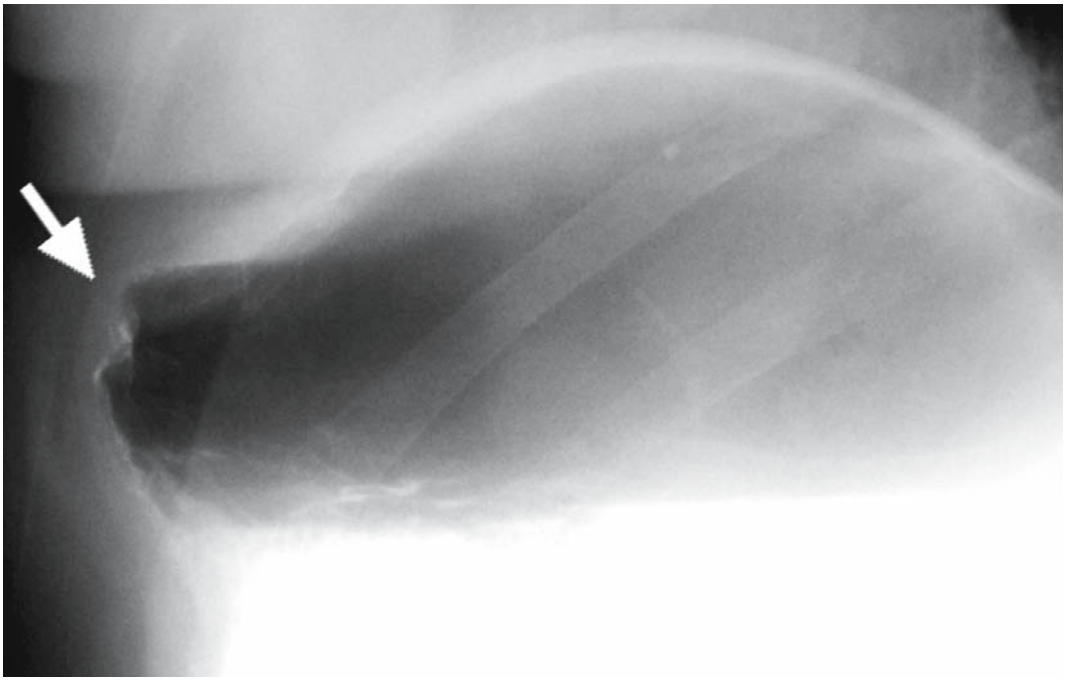
▼ Fig. 149 b.



▲ Fig. 149 c.

The additional tools available to radiological diagnosis and the improved methodological approaches to detecting gastric cancer can provide a new assessment of the structure of tumors not only by their localization, but also, in most cases, by the character of spread of the malignant process. The accumulated material shows the necessity of revising the role of radiological examination in the early diagnosis of diffuse cancer. Potentials of radiological diagnosis are important not only to create optimal conditions for taking tissue specimens for histological examinations, but also to solve some problems in situations where endoscopy fails to supply the necessary information owing to the special nature of the blastomatous process. In such cases, complicated diagnostic problems associated with endophytic cancers can be solved by radiological examinations, which visualize signs that can be considered sufficiently objective (◘ Fig. 149).

▼ Fig. 149 d.

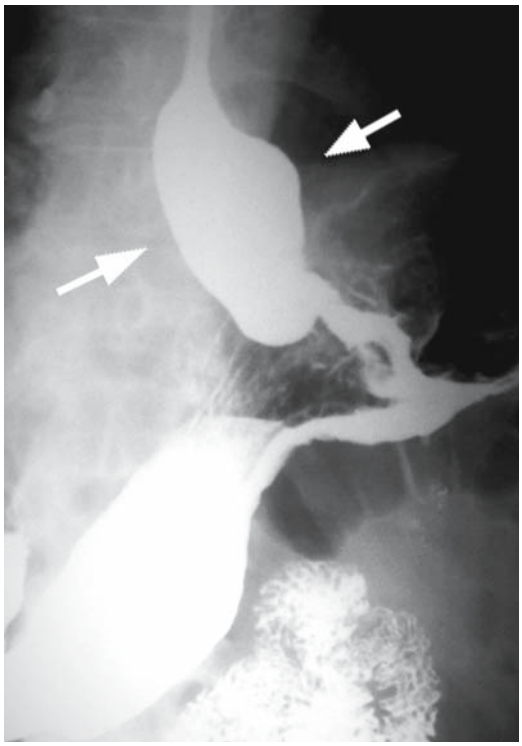


In view of what has been said, the problems of diagnosing cancer in those parts of the stomach that are inaccessible for adequate examination due to their specific anatomical features can be considered in quite a new aspect. While the studies on the anterior wall were started only recently, such anatomical parts of the stomach as the upper and the pyloric parts are discussed in any manual or study worthy of mention. These manuals and studies, however, do not consider the methodological and semiotic »supplements« to radiological examination of the stomach that we have mentioned here, made necessary by the substantial changes that have taken place in the morphogenesis of cancer and regarding its primary localization in various parts of the stomach.

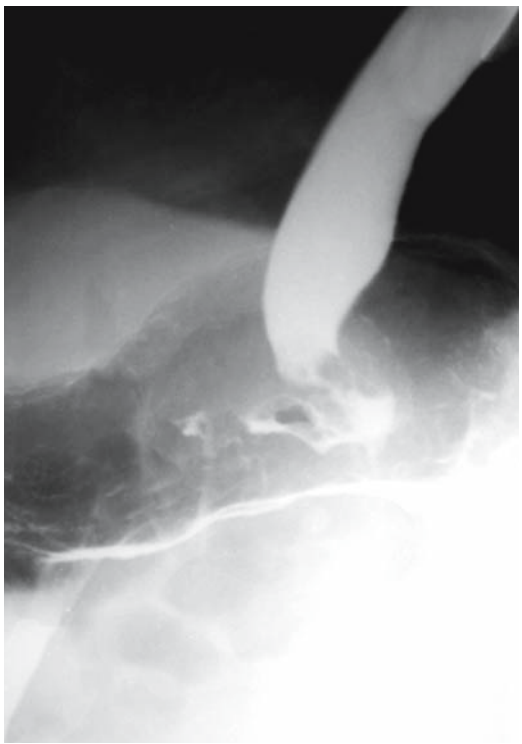
The methods currently used to examine the upper part of the stomach rely on adequate impregnation of its mucous membrane with barium sulfate suspension. This is attainable by tight filling of the stomach and (in view of the specific relief of the mucous membrane) by adequate stretching of the stomach fundus using a gas-producing mixture with double contrast. Adequate selection of a projection for taking X-ray pictures is another important prerequisite to a good examination of the upper part of the stomach (Fig. 125). Although the current standardized method calls for inspection of this region with the patient in several positions, additional techniques must be used in each particular case in the presence of even minimal deviations from the X-ray »standard« [27, 33, 35]. The main projections for examination of the upper part of the stomach are the following:

- Vertical position:
  a. Anterior
  b. Left lateral
- Horizontal plus half-vertical positions:
  a. Left posterior oblique
  b. Left lateral
  c. Left anterior oblique
  d. Right anterior oblique

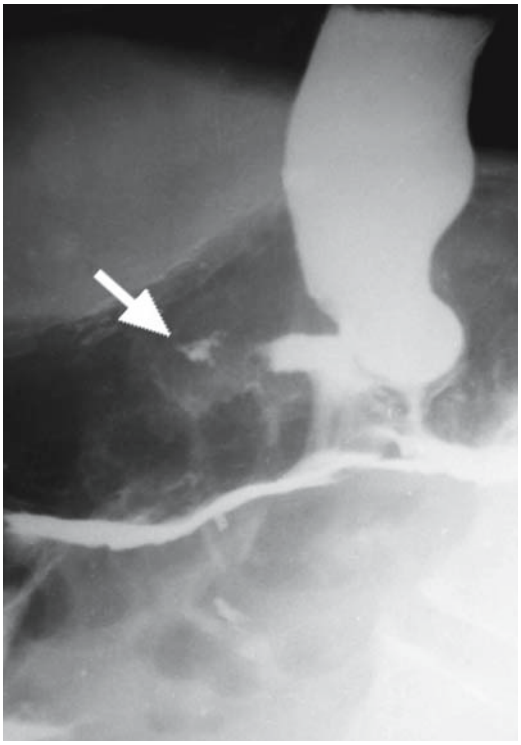
The most effective positions (as proved by practical experience) are left posterior oblique and left lateral projections with the patient in the horizontal position or half-vertical position, especially when the cardia is examined (Fig. 126).



▲ **Fig. 125 a.**



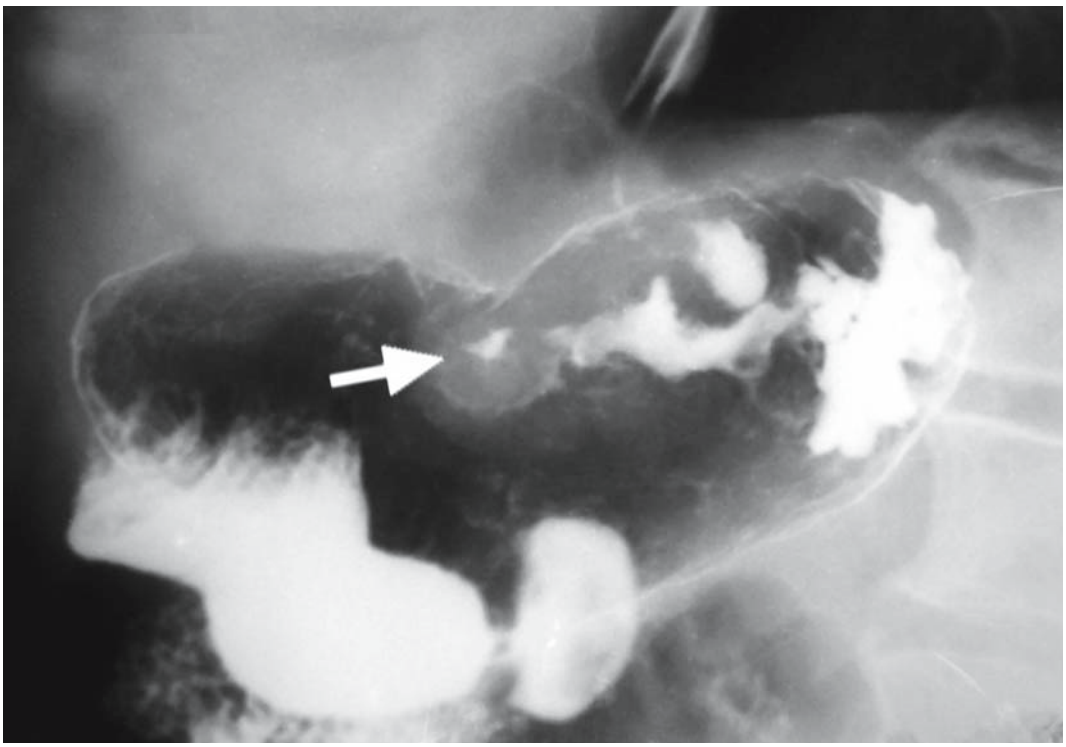
▼ **Fig. 125 b.**



▲ **Fig. 125 c.**

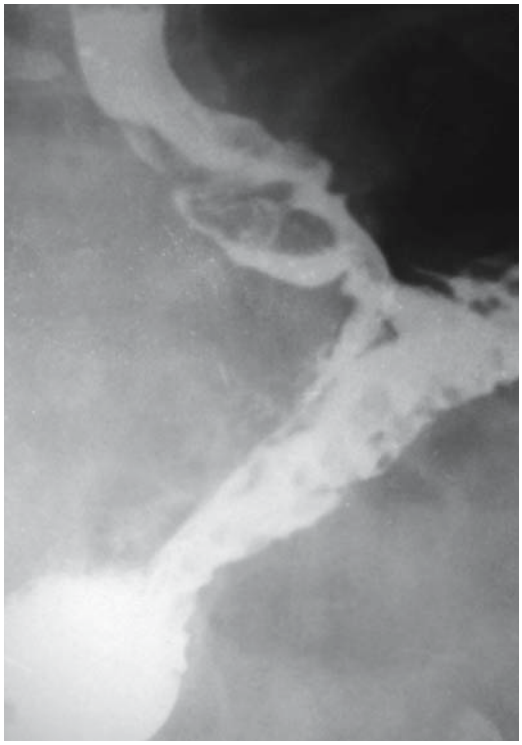
Fig. 125 a–d. Patient K., age 68. Diagnosis: gastric cancer. According to the patient's estimate, he had been ill for a month, since the day when he first experienced difficult passage of food through the esophagus. A week earlier, epigastric pain developed, for which the patient sought medical aid. Anamnesis revealed the following: for about 8 months the patient had experienced attacks of unmotivated general weakness, occasional discomfort after ingesting solid food, which made him drink water. Later the patient adapted to a special diet and no longer felt discomfort. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection) at the moment of contrast medium passage through the gastroesophageal junction: marked deformation of the upper part of the stomach, the wall of the lesser curvature is thickened, the abdominal segment of the esophagus is strongly disfigured and narrowed in the immediate vicinity of the cardia, its walls are uneven and rigid due to infiltration, suprasthenic dilation of the esophagus over the point of narrowing (arrows) which suggests long-standing difficult patency. **b** Stomach roentgenogram (double contrast, vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: the abdominal segment of the esophagus near the cardia is narrow; atypical relief of the cardioesophageal junction. **c** Stomach roentgenogram (double contrast, vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: uneven narrowing and disfiguring of the abdominal segment of the esophagus,

▼ **Fig. 125 d.**



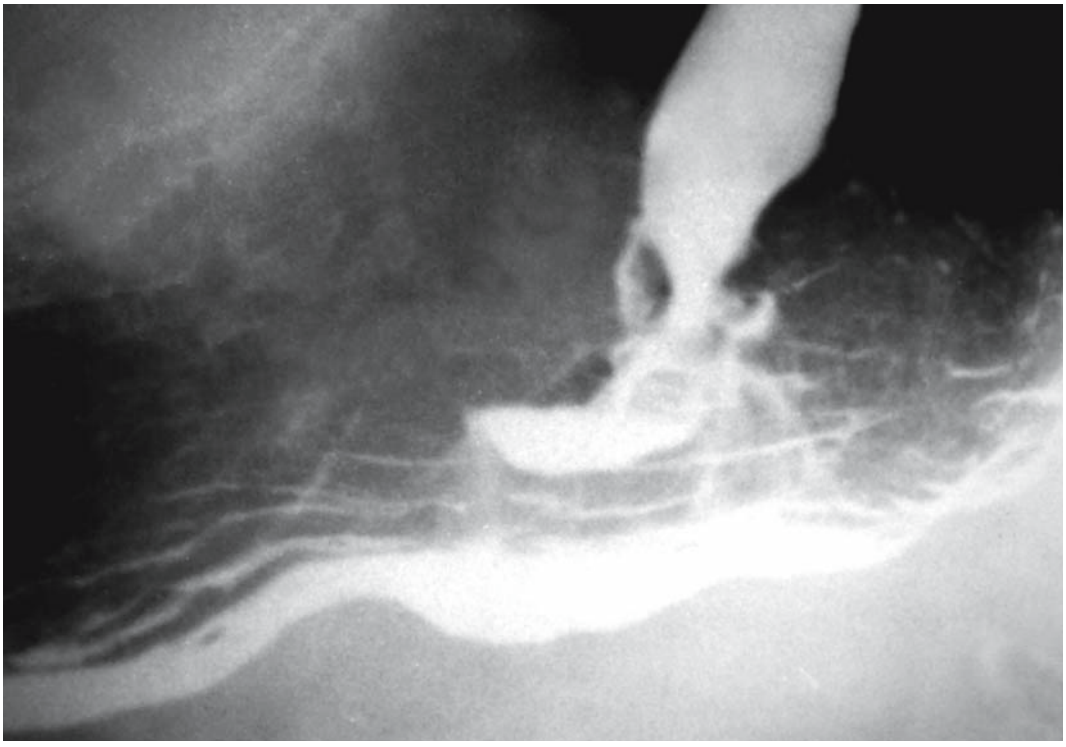
suprasthenic dilatation of the esophagus above the infiltrated part, a depot of contrast medium surrounded by a ridge of infiltration (arrow). **d** Stomach roentgenogram (double contrast, horizontal position, left lateral projection): anterior wall of the upper part is thickened due to intramural infiltration; more distinctly visualized is a depot of contrast medium surrounded by a ridge of infiltration (arrow). Conclusion: Infiltrative-ulcerous cancer of the upper part of the stomach with invasion of the esophagus. The patient was operated. Histologically, signet-ring cell carcinoma.

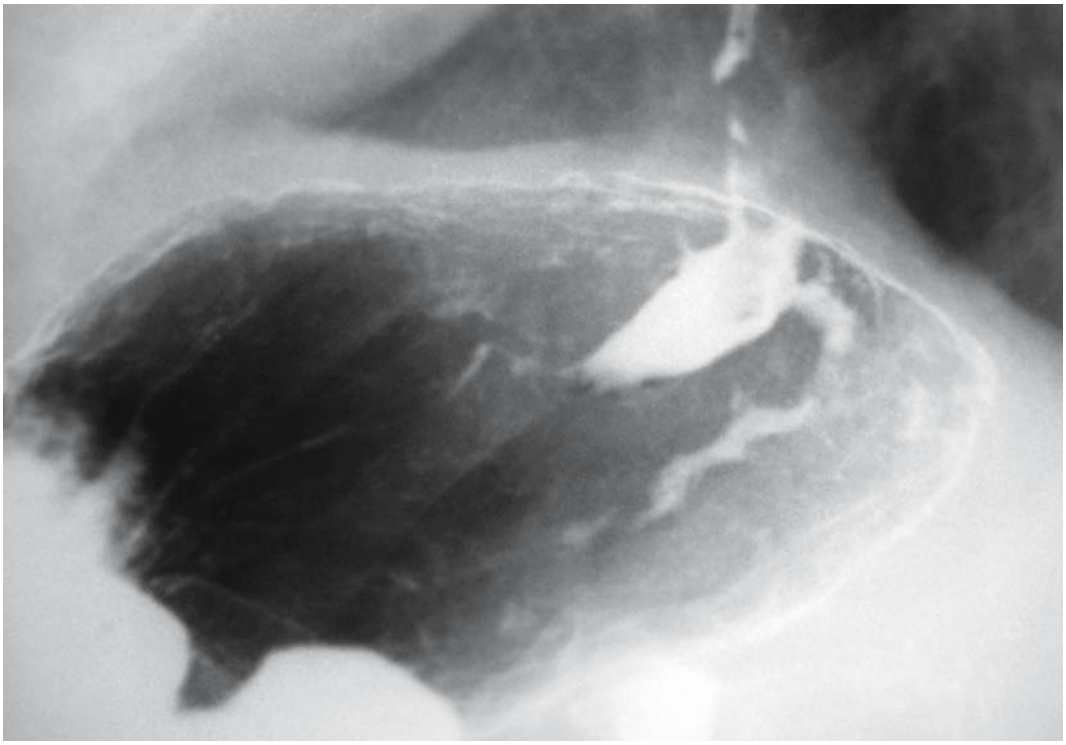
Fig. 126 a–c. Female patient T., age 68. Diagnosis: gastric cancer. **a** Stomach roentgenogram (tight filling, vertical position, anterior projection) at the moment of contrast medium passage through the gastroesophageal junction: moderately pronounced deformation of the subcardiac part, insignificantly shortened lesser curvature, its contour is uneven, marked deformation of the abdominal segment of the esophagus. **b** Stomach roentgenogram (double contrast, vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: the abdominal segment of the esophagus is unevenly narrowed. **c** Stomach roentgenogram (double contrast, horizontal position, left posterior oblique projection): atypical relief of the cardiac rosette (cardioesophageal junction), the specific radiating pattern is absent. Conclusion: Infiltrative cancer of the upper part of the stomach with invasion of the esophagus. The patient was operated. Histologically, signet-ring cell carcinoma.



▲ **Fig. 126 a.**

▼ **Fig. 126 b.**





▲ Fig. 126 c.

▼ Fig. 127 a.

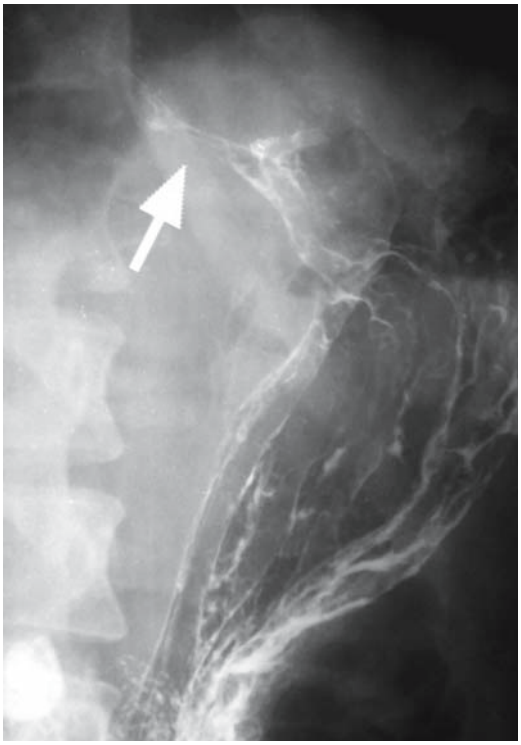
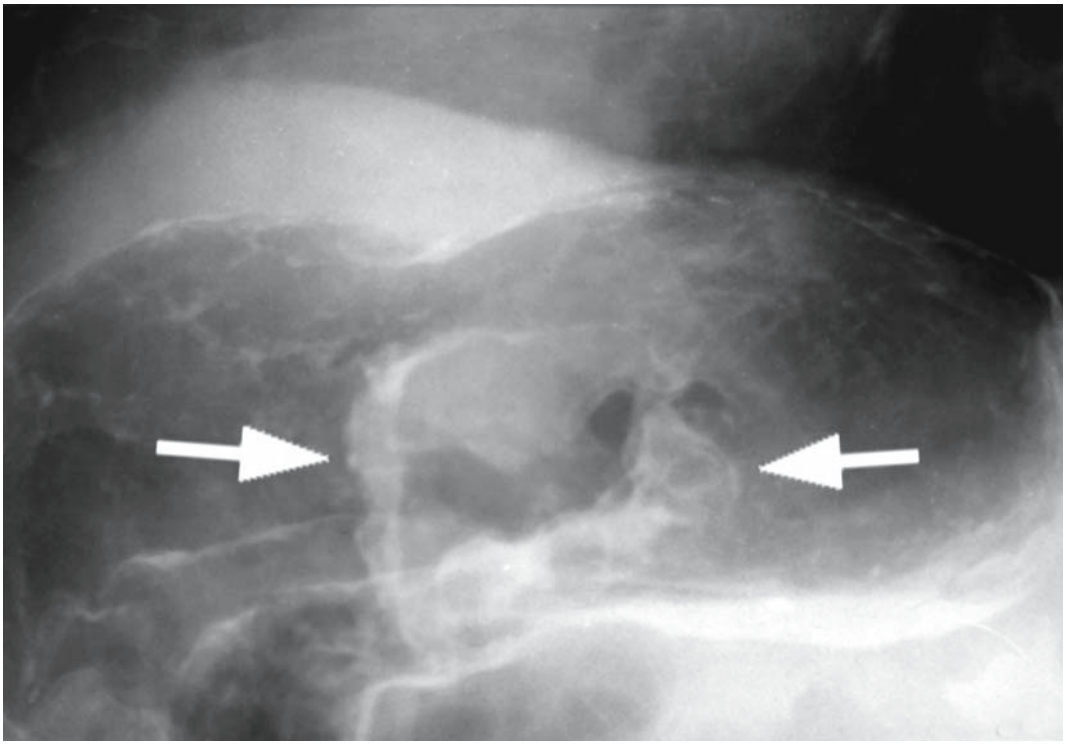
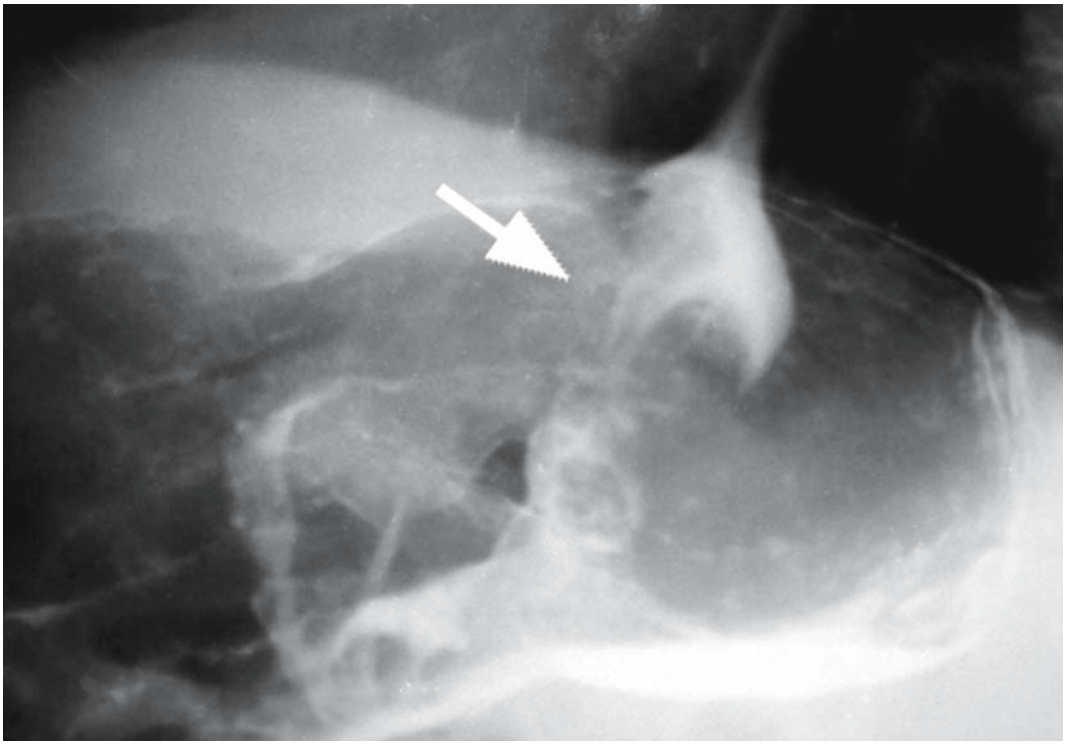


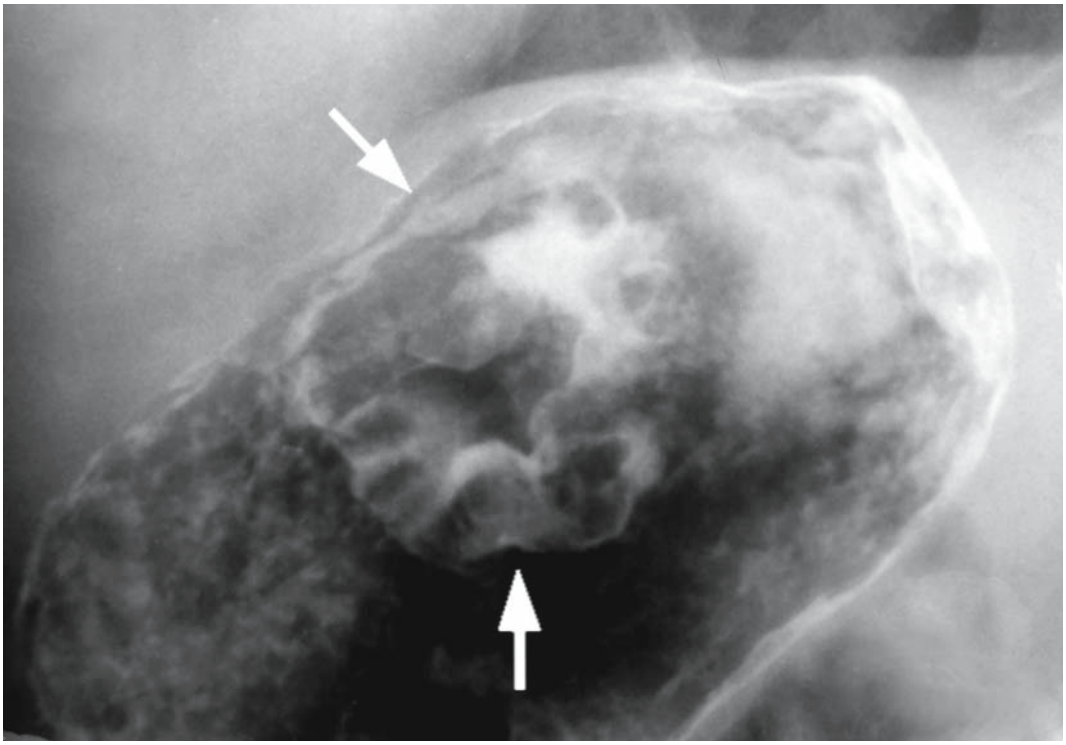
Fig. 127 a–f. Female patient B., age 60. Diagnosis: gastric cancer. **a** Roentgenogram of upper part of the stomach (vertical position, anterior projection): the air bladder is disfigured due intramural infiltration of the upper part of the stomach, the abdominal segment of the esophagus is narrowed unevenly (arrow). **b** Roentgenogram of upper part of the stomach (vertical position, left lateral projection): the walls of the subcardiac and cardiac parts are thickened due to intramural infiltration, light central spot of the ulcer crater (arrows). **c** Roentgenogram of upper part of the stomach (vertical position, left lateral projection) at the moment of contrast medium passage through the gastroesophageal junction: the abdominal segment of the esophagus is narrowed unevenly, its contour is eroded and uneven (arrow), atypical relief of the cardiac cardioesophageal junction. **d** Roentgenogram of upper part of the stomach (double contrast, horizontal position, left lateral projection): a ridge of infiltration with the light center (arrows) is visualized in the projection of the subcardiac part and cardioesophageal junction. Conclusion: Infiltrative-ulcerous cancer of the upper part of the stomach with invasion of the esophagus. **e** Macrospecimen of the resected stomach: tumor tissue of the upper part of the stomach with the ulcer in the center (black arrows). Infiltration spreads onto the esophagus (white arrows). **f** Fragment of the macrospecimen (strip): stomach wall is thickened due to white intramural infiltration (arrows). Histologically, adenocarcinoma with the signet-ring cell component.



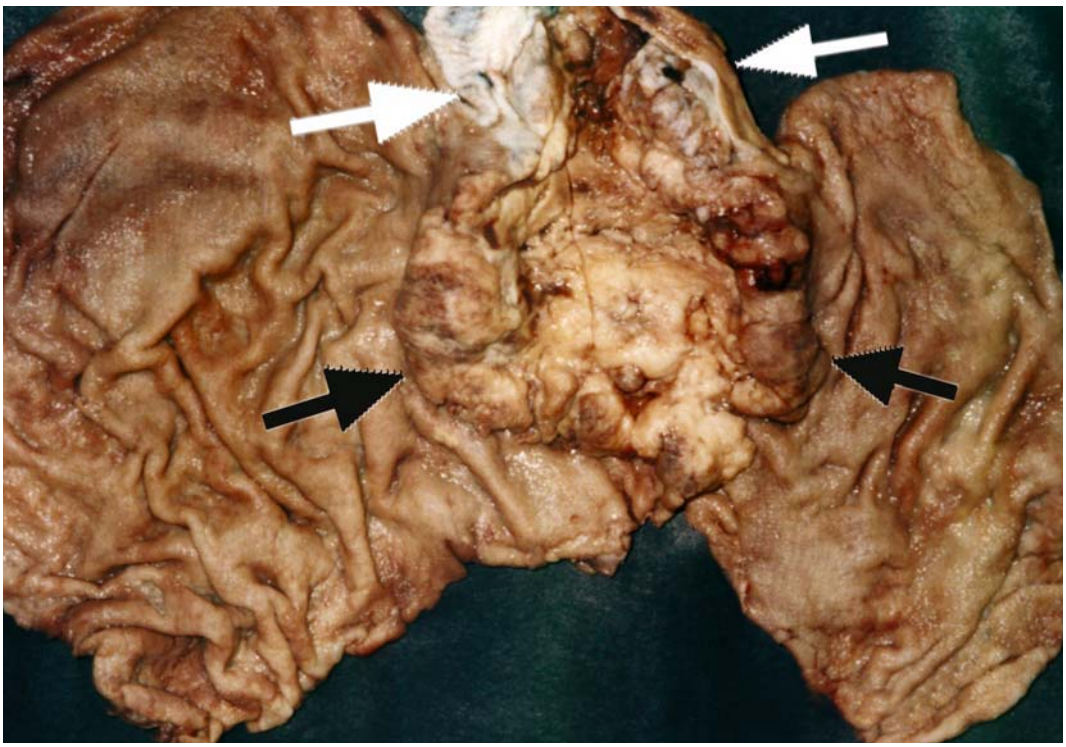
▲ Fig. 127 b.



▼ Fig. 127 c.



▲ Fig. 127 d.



▼ Fig. 127 e.

▲ **Fig. 127 f.**

Before discussing radiological semiotics, it is necessary to dwell on some aspects that are characteristic for this localization. Opinion has it that cardioesophageal cancers are different in some aspects from tumors in other parts of the stomach. This pertains mostly to exophytic growth, considerable association with intestinal metaplasia, histological differentiation which is more conspicuous compared with cancers of other localizations in the stomach, etc. Therefore, the sign proposed by Kirklin (1939) is still considered to be the main one in roentgenological diagnosis of proximal gastric cancer. However, according to our observations, diffuse tumors generally prevail in the upper part of the stomach. We observed a predominantly intramural character of tumor propagation in more than 70% of cases of blastomatous affection of the upper part of the stomach. In other cases, we usually observed mixed growth of the tumor (◘ Fig. 127).

While appreciating the serious research conducted by many authors, we explain this phenomenon as follows. Keeping in mind the role of submucous infiltrative cancers, we think that the tumor most probably spreads from the underlying parts (the greater curvature in particular). Infiltrative cancer known as linitis plastica, which affects the entire stomach, has long been known. Spread of the tumor in the proximal direction was reported by T. Okamoto et al. (1988), and Levin at al. (1990). They noted that affection of the upper part of the stomach is characteristic more of young patients than of the elderly. At the same time, the problem of diagnosing infiltrative cancer of the upper part of the stomach remains unsolved.