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Author(s)	齊藤, 昭三; 登田, 尚良; 松本, 満臣 他
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# Roentgenologic Studies on Diseases of the Stomach Report 4. Radiographic Differentiations of Benign and Malignant Ulcers of the Stomach

Shozo Saito, Naoyoshi Toda, Mitsuomi Matsumoto and Tatsuo Tobe  
Department of Radiology, Gunma University School of Medicine, Maebashi

## 胃疾患に関する X 線学的研究

### 第4報 潰瘍病変の良・悪性の鑑別診断について

群馬大学医学部放射線科教室

齊藤 昭三 登田 尚良 松本 満臣 戸部 竜夫

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胃における潰瘍病変、特に早期病変の良、悪性の鑑別には、先づその微細病変を良好に描出しなければならない。このためには副交感神経遮断剤、消化酵素剤、酸中和剤等による前処置が極めて有効であつた。

以上の前処置により、悪性潰瘍の微細構造をみると、胃小区像は病変部において不規則に断裂し、潰瘍周辺の堤防状隆起を示す症例においては、その部の胃小区像は、大小不同、あるいは不規則な腫大を示した。その他、従来報告されているレリーフ像の中断、階段状狭窄あるいは隆起、不規則ないし多角形のしばしば外に向つて陥凹する潰瘍辺縁、二重輪廓、不規則ないし島状隆起を示す潰瘍底等の所見をも良好に描出することが出

来たので、自験例を中心にその診断的意義を比較検討した。

病変の描出に際しては胃充盈像、二重造影、圧迫法等のおのおのについて可能な限り正面像に加えて側面像、斜位等の撮影を併用し、造影剤の量についても小量、中等量、大量を用い、病変部ならびにその周辺の胃壁の伸展性等をも観察することにより、病変の良、悪性の鑑別のみならず、病変の広がり、深さ等をもある程度推定することが出来た。

しかしながら病変の良、悪性の鑑別には、個々のX線所見については例外も多いので、従来云われているように、総合的なX線診断に加えて、内視鏡、細胞診等の併用が望まれる。

## Preface

Many studies of the radiographic differentiation of benign and malignant ulcers of the stomach have been made up to the present. However, both types of ulcers cannot always be differentiated, in spite of refined methods of examinations, especially in early ulcerating cancers and benign ulcers the differentiation may be one of the most difficult radiological problems.

The purpose of this paper is to call attention to the difference of fine relief of the lesions between them.

## Materials and Methods

In the past 4 years, 5 ulcerating early gastric cancers (the lesion confined to the mucosa, lamina propria, or submucosa), 5 slightly advanced gastric cancers (the lesion partially reached to the muscular coat),

16 benign small gastric ulcers (below 5 mm. in diameter), 7 benign middle-sized ulcers (6 to 15 mm. in diameter), and 5 benign large ulcers (above 16 mm. in diameter) were selected at random in the Radiology Department of Gunma University Hospital

In these 10 ulcerating gastric cancers and 28 benign gastric ulcers, X-ray and gastroscopic examinations were made in all cases. Moreover, in all gastric cancers and 16 benign ulcers, gastric operations were made, and the diagnosis was histologically confirmed.

The roentgenograph was first made without any pretreatment. Then the following pretreatment was made (Saito et al. 1966): Parasympathetic blocking agents, digestive enzymes, and neutralizers were given for 4 consecutive days, and on the morning of the 5th day, 15 minutes prior to roentgenography, Buscopan (hyoscin-N-butylbromide) (Murray, 1966) was intramuscularly injected. In cases of hypersecretion of gastric juice, the removal was previously made by gastric tube.

Mucosal folds technique with small amounts of barium (20 to 50 cc.) is most liable to be affected by mucus or hypersecretion. Taken, therefore, in prone position, it acts as a compression technique or a prone double contrast.

In compression technique about 30 to 150 cc. of barium were used.

In prone double contrast, about 200 to 300 cc. of air and 20 to 50 cc. of barium were administered. In supine or erect double contrast, about 200 to 300 cc. of air and 100 to 200 cc. of barium were given.

In double contrast, air was introduced into the stomach by gastric tube or straw with a small perforation (Amplitz, 1958).

## Results

### 1. Contour of the stomach

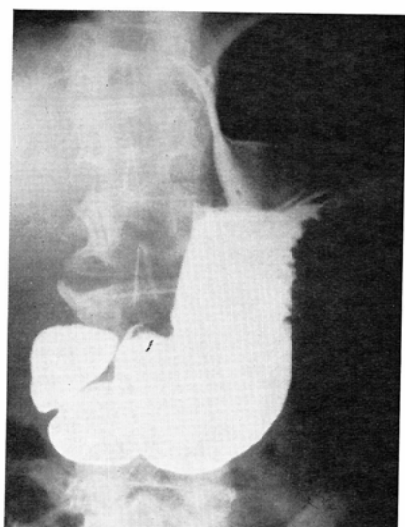
In 6 out of 10 cases of ulcerating gastric cancers, the lesions were located the lesser or greater curvatures (profile lesion) and showed rigid, irregular contour, opened angle, shortening of the curvature, or indentation on the opposite side. The peristalsis was diminished or absent at the sites of the lesions. In 5 of 6 cases, the niche did not project beyond the luminal contour. However, in one case the niche projected beyond to luminal contour. According to compression technique, the so-called Carman's Meniscus sign was observed.

In 2 of the 10 cases, the lesions located near the curvatures (semi-profile lesion). In another 2 cases the lesions were located away from the lesser or greater curvature (en face lesion). In these semi-profile and en face lesions, changes in contour and peristalsis were less remarkable.

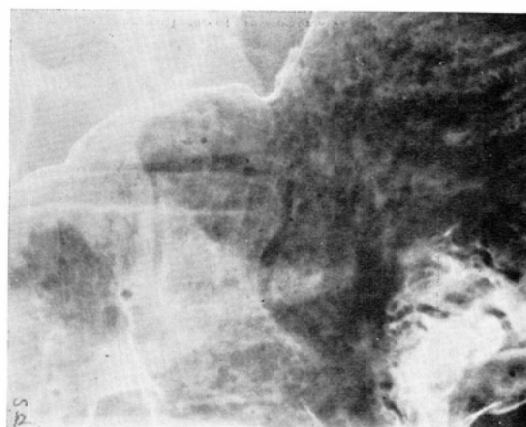
In benign ulcers the lesions also showed opened angle, shortening of the lesser curvature or indentation on the opposite curvature, while in profile lesion the niche generally projected beyond the luminal contour. Rigid or irregular contour generally was not observed and the peristalsis was not as diminished as in cancer, especially in small en face ulcers. However, in large or cicatricial ulcers the contour was rigid and irregular, and the peristalsis markedly diminished or absent. Furthermore, in one case the Meniscus sign was observed.

### 2. Changes in gastric area

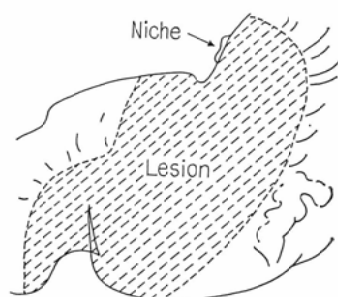
According to pretreatment, the gastric area was clearly visualized in 7 of the 10 ulcerating cancers. In one case of superficial spreading early gastric cancer, the gastric area was irregularly interrupted at sites of the lesion. This change was most effectively visualized by means of double contrast technique



(A)



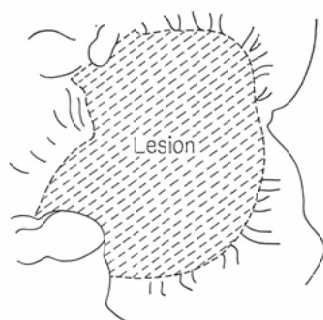
(B)



(C)



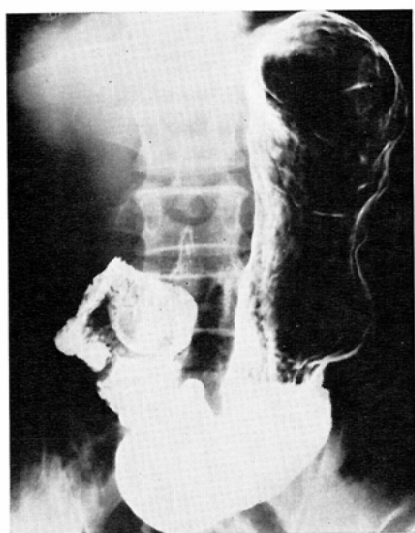
(D)



(E)

Fig. 1. Superficial spreading early gastric cancer with ulceration

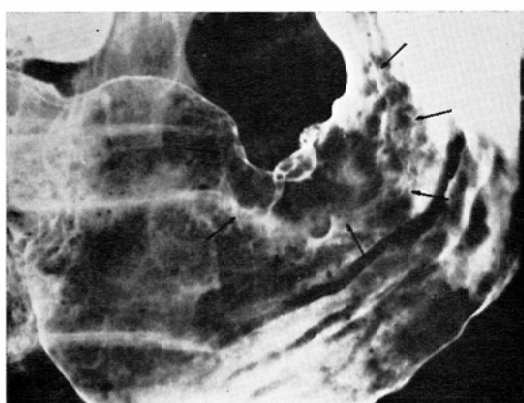
- A. Barium filled stomach shows irregular contour at the gastric angle.
- B. Supine double contrast shows irregularly interrupted gastric area at sites of the lesion (See Fig. C)
- C. Diagrammatic drawing of B.
- D. Resected specimen. Compare with B. (Note changes in mucosal folds and gastric area.
- E. Diagrammatic drawing of D.



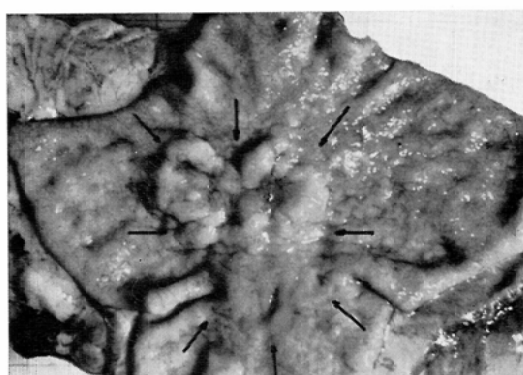
(A)



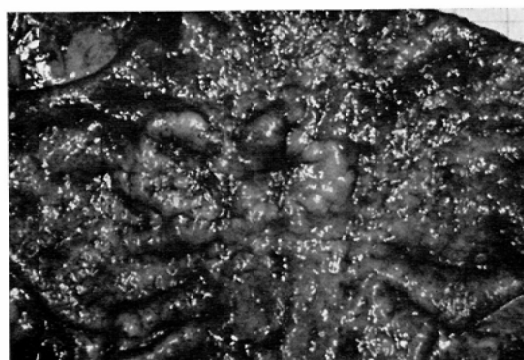
(B)



(C)



(D)



(E)

Fig. 2. Gastric cancer with ulceration

- A. Barium filled stomach shows irregular and rigid contour at the angle.
- B. Gastrosopic picture shows a profile view of the lesion at the angle.
- C. Supine double contrast shows protruding lesions with ulceration (arrow)
- D. Resected specimen shows protruding cancer with ulceration.
- E. A close-up view of the resected specimen shows interrupted mucosal folds and irregularly interrupted or enlarged gastric area at sites of the lesion. Compare with benign ulcers (Fig. 4)

(Fig. 1). In another 9 cases of ulcerating gastric cancer, the gastric area at sites of the lesions also irregularly interrupted or enlarged, and in the ulcerating portion the gastric area was absent. These changes were well visualized, according to combined application of pretreatment and double contrast or compression technique. On the macroscopic appearance of the 10 resected specimens, the gastric area was also irregularly interrupted, or enlarged at sites of the lesions (Fig. 1D, 2D).

However, in 8 of the 28 benign ulcers, the gastric area in the surrounding of the ulcers was somewhat irregular or absent due to edema, inflammation or fibrosis. However, generally the gastric area in benign ulcers was not irregularly interrupted, enlarged or protruded as in malignant ulcers.

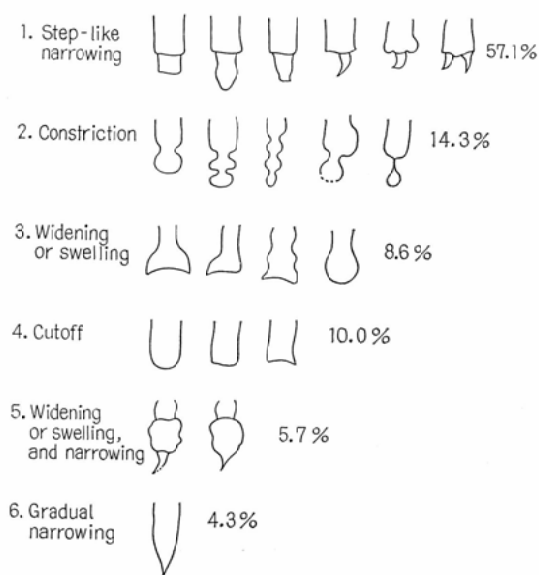


Fig. 3. Changes in mucosal folds of resected specimens: Malignant ulcers (9 lesions including 70 mucosal folds)

### 3. Changes in mucosal folds

Mucosal folds at the margin of malignant ulcers showed a step-like narrowing, sudden cutoff, constriction, or widening, as shown in Fig. 3. However, in one case of longstanding chronic ulcer associated with malignant degenerations, the mucosal folds became gradually thin as in benign ulcers.

While generally in benign ulcers, convergence of the mucosal folds was observed, and the mucosal folds became gradually thin (Fig. 4). However, in a few cases the break of the folds, step-like narrowing, constriction, and widening were found (Fig. 5, 6).

### 4. Shapes of ulcers

In 3 cases of early ulcerating gastric cancer, irregular, polygonal, sharply demarcated ulcers with concave margins were clearly visualized by double contrast or compression technique (Fig. 7). In another 7 cases of malignant ulcer irregularly demarcated ulcers were also observed by these techniques. In 6 cases out of 10 ulcerating cancers, the margin appeared as an irregularly elevated bank (Fig. 2), and the

gastric area in this portion was irregularly enlarged and protruded (Fig. 2D).

In 22 cases of the 28 benign ulcers, the shape of the ulcers was smooth and round or oval. In 3 cicatricial ulcers, the margin was irregular. In another 2 cases, the margin was polygonal with concave margins, as in a malignant ulcer. However, the ulcer floor and mucosal folds were generally smooth.

#### 5. Floors of ulcers

In 7 of 10 cases of ulcerating gastric cancers, the floor was uneven or irregular, and in 3 of the 10 cases, several islets were found within the ulcer. These changes were most effectively demonstrated by compression technique with various pressures, such as slight, moderate and strong pressures.

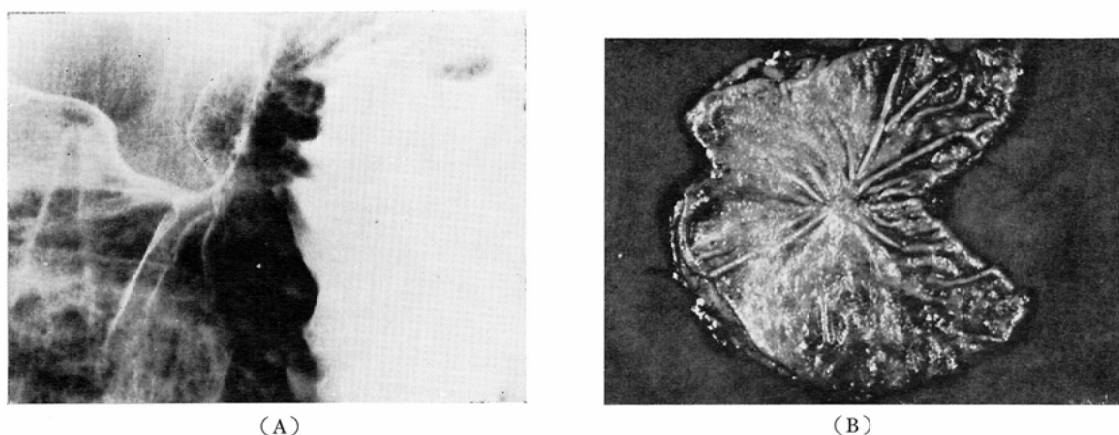


Fig. 4. Large benign ulcer

- A. Supine double contrast shows a large benign chronic ulcer with converged mucosal folds.  
 B. Resected specimen shows the same findings. Compare with malignant ulcers or erosion (Figs. 1D, 2E)

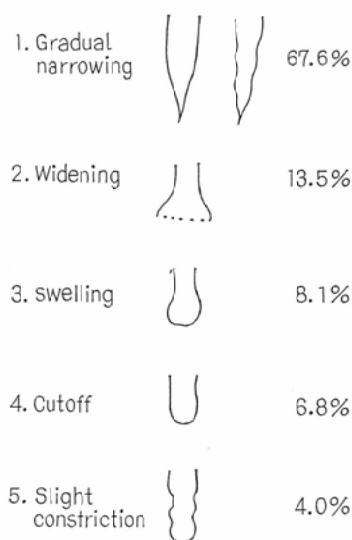
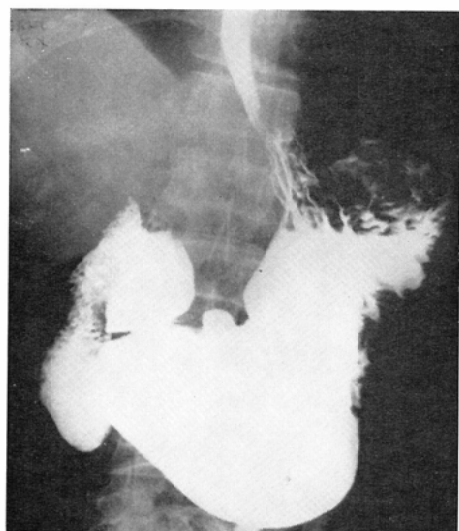
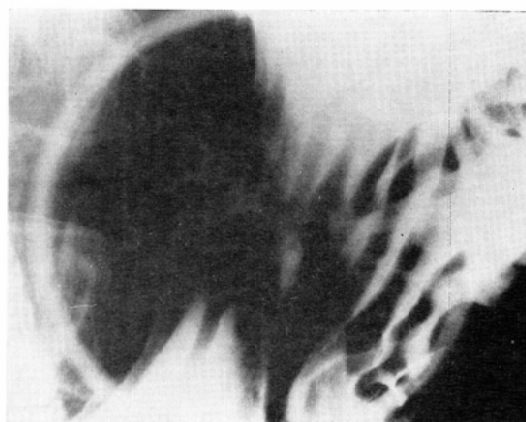


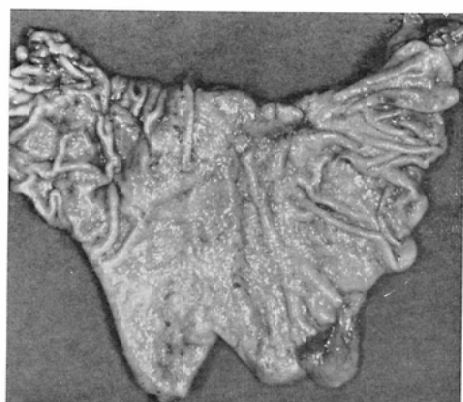
Fig. 5. Changes in mucosal folds of resected specimen: Benign ulcers (10 lesions including 74 mucosal folds)



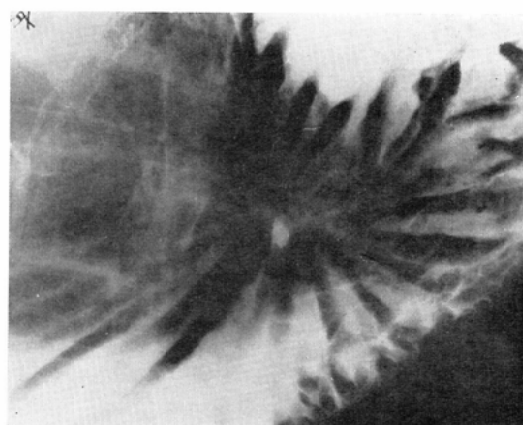
(A)



(B)



(C)



(D)



(E)

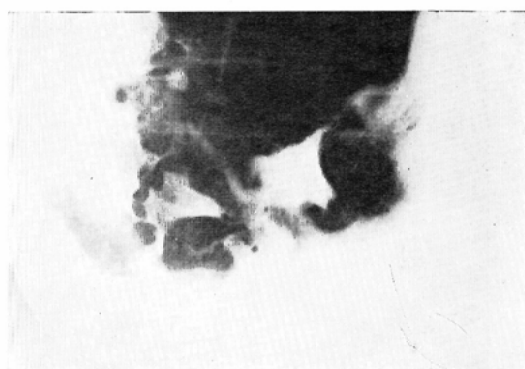
Fig. 6. Benign gastric ulcers

- A. Barium filled stomach shows irregular contour and shortening of the lesser curvature.
- B. Compression technique shows several ulcers.
- C. Double contrast shows several ulcers. In some mucosal folds, the widening, swelling and cutoff are seen.
- D. Resected material
- E. A close-up view of the resected material shows step-like narrowing, widening, swelling and cutoff of the mucosal folds (arrow) as in malignant ulcers.

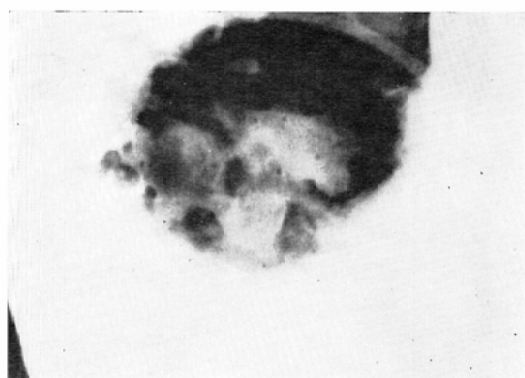




(A)



(B)



(C)

Fig. 7. Ulcerating gastric cancer

- A. Barium filled film shows opened angle and irregular contour at the angle
- B. Compression technique shows irregularly polygonal and sharply demarcated ulcers with concave margins (First examination)
- C. This compression technique was made 10 days after the first examination. The ulcers were enlarged after this short period of time.

In 23 of 28 cases of benign ulcers, the floor was generally smooth and the nodularity within the ulcer was not observed. In another 5 cases the floor was somewhat irregular.

#### 6. Effects of medical treatment

In 3 of the 10 cases of ulcerating cancers, X-ray examinations were made 10 days after the first examination, and the ulcers were enlarged after this short period of time (Fig. 7).

Conversely, in the benign ulcers, the lesions generally diminished in size after the treatment.

### Discussion

The roentgenograph of early or small lesions are so unfavorably affected by the gastric mucus, necrotic substance or hypersecretion that pretreatment are necessary, such as administrations of parasympathetic blocking agents, digestive enzymes, and neutralizers, or in cases of hypersecretion the removal of gastric juice by stomach tube (Aoyama 1961, Saito et al. 1965, 1966).

As a rule benign ulcers characteristically have a smooth outline and the peristalsis tends to be active, whereas malignant ulcers show some irregularity or rigidity in their contour and peristalsis is diminished or absent (Stein, 1966). However, in our 3 cases of longstanding chronic ulcer, the lesion were irregular and rigid, and peristalsis at sites of the lesions was markedly diminished or absent. In 2 cases of en face early cancer, the contour was almost normal and peristalsis showed little change. For the demonstration of abnormal contour and peristalsis in small lesions, the X-ray films must be taken in profile view. When viewed in profile, a malignant ulcer usually does not project the lumen of the stomach. However, when an ulcer projects beyond the luminal contour and Hampton's line, ulcer collar and ulcer mound are seen by compression technique, the lesion is said to be benign (Wolf and Marshak, 1957). However, in one of our malignant ulcers, the niche projected beyond the luminal contour.

In the surrounding area of ulcerating cancers generally the gastric area was irregularly interrupted, enlarged, or protruded, while in benign ulcers the gastric area showed little change. For the demonstration of the gastric area double contrast with pretreatment was most valuable. In one superficial spreading early cancer, the size of the lesion could be suggested according to changes in the gastric area as shown in Fig. 1.

Concerning mucosal folds of ulcerating cancer, the break at the ulcer margin has been reported (Ichikawa et al., 1964; Shirakabe et al., 1966; Frik, 1967). According to Kalokerinos (1967), in malignant ulceration the mucosal folds usually stops short of the edge, and the ends show sudden cutoff, tapering, swelling, and erosion. A clubshaped widening of the folds is also reported (Frik, 1967). In our cases of ulcerating cancers as shown in Fig. 3, sudden cutoff, step-like narrowing, constriction and widening of the mucosal folds were highly significant. However, in a few cases of benign ulcers the mucosal folds showed the cutoff, step-like narrowing and widening as in malignant ulcers (Fig. 5, 6). Generally in benign ulcers convergence of the mucosal folds was visualized. However, in one case of longstanding chronic ulcer which had undergone malignant degeneration, the mucosal folds were converged and became gradually thin as in benign ulcers. Such cases are also reported by Marshak et al. (1953) and Shanks (1958). Therefore, the differentiation in such cases may be extremely difficult.

According to previous reports, multiple gastric ulcers are more often benign, and the Meniscus sign of Carman is highly suggestive of ulcerating cancer (Shanks, 1958; Teschendorf, 1964; Stein, 1966; Zboralske, 1967; Frik, 1967). However, in one of our early cancers the lesion is associated with multiple gastric ulcers, and in one case of cicatricial benign ulcer, the niche showed the Meniscus sign.

In regard to shapes, malignant ulcers often showed an irregular polygon with concave margins and sharply demarcated. While in benign ulcers the shape was generally smooth and round. In 3 cicatricial benign ulcers the margin was irregular, and in another 2 cases, the shape was polygonal with concave margin as in cancers. However, the floor of the ulcer was smooth and the mucosal fold converged.

As for floors of malignant ulcers, they were uneven, irregular and nodular, and within the ulcer several islets were found. The irregular floor was most effectively demonstrate by means of compression technique with graded pressure, such as slight, moderate and strong pressures. In benign ulcers the floor was generally smooth, except for 3 cicatricial ulcers.

In response to medical treatments, a simple ulcer showed healing in 3 to 4 weeks under treatment, but a malignant ulcer will not (Cole, 1928; Gutmann, 1956; Shanks, 1958). However, the malignant ulcer

may also, for a time, get smaller during treatment of peptic ulcer (Schindler and Gold, 1939; Hellmer, 1946; Grimes and Bell, 1950; Shirakabe et al., 1966). In our 3 cases of ulcerating cancer, the X-ray examination was made under treatment of 10 days after the first examination, and the ulcers were enlarged in all cases. However in benign ulcers, as a rule, they were remarkably diminished.

Furthermore, large ulcers, shallow or flattened ulcers, and ulcers in the fornix or on the greater curvature, were said to be predominantly malignant (Alvarez and McCarty, 1928; Shanks, 1958; Teschendorf, 1964; Frik, 1966, 1967; Stein, 1966). However, these signs are of little significance for the differentiation.

Therefore, a synthetic differential diagnosis is necessary. Furthermore, the combined application of the X-ray examination, gastroscopy, and gastric cytology is desired.

### Summary

For the radiographic differentiation of benign and malignant ulcers, the fine relief radiograph of the lesion was important, especially in early or small lesions.

For the radiograph of the fine relief, double contrast with pretreatment and compression technique were most valuable. Mucosal technique in erect position with small amounts of barium was generally unsatisfactory, therefore, it may be necessary to place the patient in prone position, for in this position a compression element or a double contrast element is added.

The most characteristic X-ray finding of ulcerating early gastric cancers are as follows:

The gastric area surrounding ulcers was irregularly interrupted, or enlarged and protruded. In regard to mucosal folds at the margin, the folds showed sudden cutoff, steplike narrowing, constriction, or widening. Shapes of the ulcer were irregular or polygonal, and sharply demarcated. In some cases, the margin showed a bank-like elevation, and in this position the gastric area was irregularly enlarged and protruded. Floors of the ulcer were generally uneven or irregular, and within the ulcer several islets were often found. For demonstration of the irregular floor, compression technique with various pressures, such as slight, moderate and strong pressures, was valuable.

However, the radiographic differentiation of benign ulcers and ulcerating early cancers was often difficult; therefore, gastroscopic and cytologic examinations are also desired.

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