Roentgenologic Studies on Diseases of the Stomach Report 3. Diagnostic Significance of Double Contrast Technique Combined with Pretreatment and Positioning, Especially in Early or Small Gastric Lesions.

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胃疾患に関するX線学的研究 第3報 胃早期病変における二重造影，前処置，並びに体位変換法等の診断学的意義

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胃疾患のX線撮影に際しては，先づ無処置で撮影を行ない，診断不明なもの，癌，潰瘍，ポリープ等の疑われる症例に対しては，薬物による前処置，体位変換法等の併用を行なつたところ，胃早期病変を良好に描出することが出来た．

前処置としては，4日間副交感神経遮断剤，消化酵素剤，酸中和剤等を連続投与し，さらに5日目の早朝，検査施行15分前に Buscopan（Hyoscin-N-Butylbromide）20～40mg を筋肉注射した．

体位変換法は，先づ後壁病変に対しては，透視台上にて背臥位を経て，左右の側臥位をとらせ，これを5，6度繰返した後背臥位二重造影法を行なつた．前壁病変に対しては，腹臥位を経て左右の側臥位をとらせ，これを5，6度繰返した後，腹臥位二重造影法を行なつた．

また，前処置を行なつてから透視台上にて数回患者を回転させてから背臥位二重造影法を行なうと，後壁病変のみならずしばしば前壁病変も造影し得た．

以上の前処置，体位変換を行なつてから立位にすると胃上部病変が良好に描出された（立位二重造影法）．このようにして良好に描出された二重造影法に立体撮影を併用すると，前壁ならびに後壁病変の区別が可能であり，病変を立体的に把握することが出来た．

Preface

In 1911 the method of inflating the stomach with air was first used in combination with a contrasting emulsion by Elischer. This method was also suggested by Baastrup (1924). Hilpert (1928) used 30 grams of barium sulphate with approximately 15 grams of bolus alba and introduced about 300 to 500 cc. of air to further the study of the mucosal relief markings. It was a definite step toward pneumo-relief of the gastric mucosa. In 1937 Colcher introduced into the stomach moderate amounts of barium and air by stomach tube and obtained a satisfactory result. Later 500 to 1,500 cc. of air were injected into the

stomach by Ruzika and Rigler (1951), and 1200 to 1600 cc. of air were introduced by Eiken (1958). However, inflation with so large amounts of air tended to stretch the mucosal folds; therefore, the small lesion in the stomach could not be found. Arens and Mesirow (1937) made use of Seidlitz powders. But the double contrast film obtained, with the aid of the effervescent powder, showed a poor mucosal detail due to innumerable gas bubbles. Amplatz (1958) had utilized the "Straw Technique", i.e., a puncture in the mid portion of the straw is made to produce a small perforation. Therefore, the patient drinks both barium and air when the barium is swallowed. Then a double contrast by spraying the mucosal surface with contrast medium had been recommended by Foti (1963). However, the double contrast has not been generally accepted.

On the other hand, the mucosal relief technique was devised by Holzknecht (1911) and Rendich (1923), and elaborated by Berg (1930). And the compression technique was employed by Chaoul (1929). These techniques then came into more prominence. In the diagnosis of the early and small gastric lesions, generally the mucosal and the compression technique (Konjetzny, 1937; Prévôt, 1937, 1958; Bücker, 1941, 1944; Berg, 1950; Frik, 1958), and the barium filled stomach (Gutmann, 1937, 1956) have been employed.

In Japan the double contrast technique has been widely used (Shirakabe et al., 1959, 1966; Ichikawa et al., 1964; Saito et al., 1964, 1965, 1966, 1969). However, the combined application of the double contrast, pretreatment, positioning and stereography has not been reported at all up to the present. Therefore, the authors have undertaken to evaluate the diagnostic significance of these techniques in early and small gastric lesions.

Materials and Methods

In the past 4 years, 9 early gastric cancers (the lesion confined to the mucosa or submucosa of the gastric wall), 3 benign small gastric polyps (below 5 mm. in diameter), a small protruding lesion (below 5 mm. in diameter), and 16 benign small gastric ulcers (below 5 mm. in diameter) were selected at ramdom at the Radiology Department of Gunma University Hospital.

On these 29 cases including 38 lesions, X-ray and endoscopic examinations were made in all. Moreover, in all of the 9 early gastric cancers, in 2 of the 3 benign small polyps, and in 4 of the 16 benign small ulcers, gastric operations were made, and the diagnosis was histologically confirmed.

In roentgenography the patients were pretreated with parasympathetic blocking agents such as Finalin (benactidinbromide 100 mg/day), digestive enzymes such as Combizym (product of Luitpold, containing 25 W.U. [Willstätter Units] of protease, 14 W.U. of amylase, 12 W. U. of lipase, 20 W.U. of trypsin, and each 0.1 gr. of cellulase and hemicellulase; 6 Tablets/day), and neutralizers such as Sodium Bicarbonate. These were given for 4 days, and on the 5th morning, Buscopan (hyoscin-N-butylbromide 20 or 40 mg) was intramuscularly injected 15 minutes prior to roentgenography (Saito et al. 1965, 1966a).

When using the double contrast technique about 300 cc. of air were first injected into the stomach by gastric tube, and then about 200 cc. of barium sulphate suspension (Barexrelief 110 W/V %, product of Tokyo-Tanabe) were given.

The patient was first placed on the fluoroscopic table in the erect position, and subsequently to the vertical position, to the horizontal prone position, then to the left lateral, and finally to the supine position.

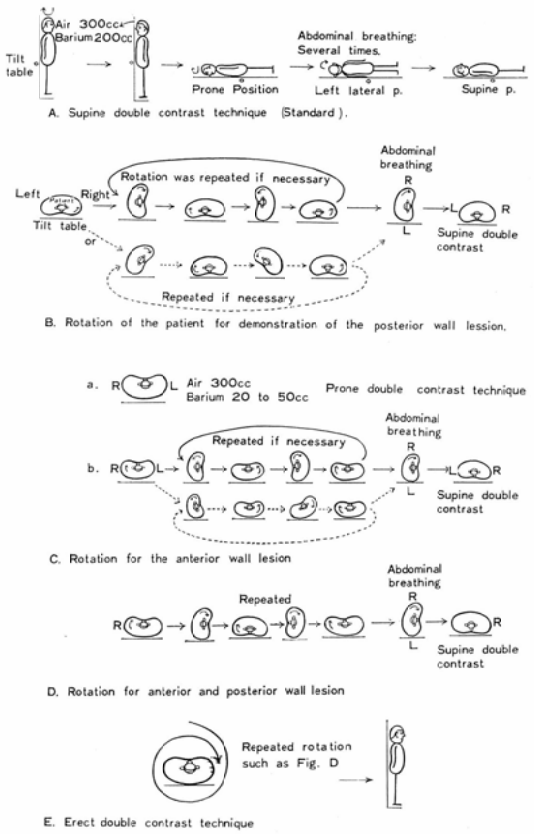
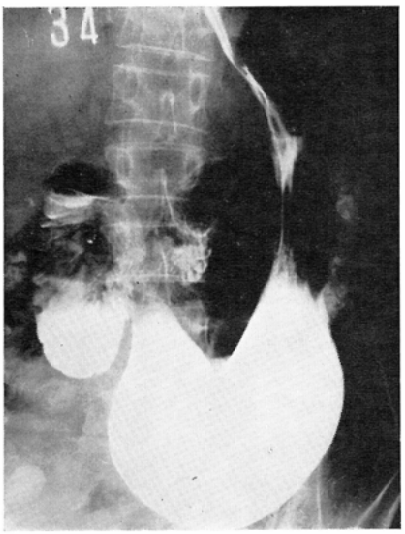


Fig. 1. Double contrast technique combined with changing position.

This is the supine double contrast (Fig. 1A). To obtain fine relief (gastric area) of the stomach, a greater degree of rotation may be necessary, and the patients was quickly rotated on the fluoroscopic table such as Fig. 1B to D. This affords an excellent double contrast study of the stomach. Spot films are also taken. The patient was then placed in 10° to 15° Trendelenburg position and rolled toward the left side, elevating the right side for varying distances. This produces the double contrast not only of the antrum and the lower body, but also of the middle or upper body of the stomach. Furthermore, in this position the duodenal bulb will fill with air and create a double contrast of this area.

When bringing the patient upright after completion of the examination in the horizontal position, the double contrast visualization of the fundus and the upper body of the stomach becomes possible. This is the erect double contrast (Fig. 1E). And, for the upper gastric lesion, face-on demonstration in the dependent position was employed (Schatzki and Gray, 1958).

For the demonstration of the anterior lesion of the stomach the prone double contrast technique was used (Fig. 1 Ba). In this method about 300 cc. of air and 20 to 50 cc. of barium were injected into the stomach.



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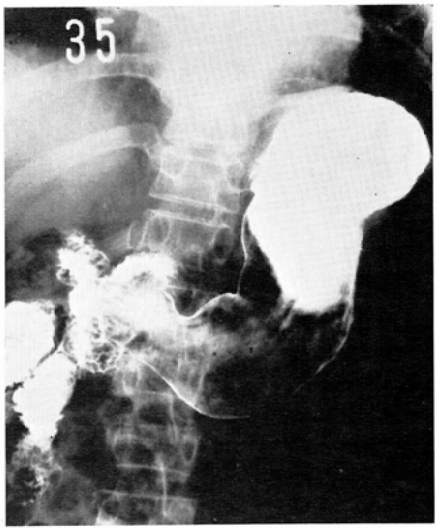


(B)

(C)

Fig. 2. Effects of pretreatment (Chronic gastritis)

A. Barium filled stomach.

B. Supine double contrast without pretreatment: Gastric area is invisible.

C. Supine double contrast with pretreatment: Gastric area is clearly visible.

Results

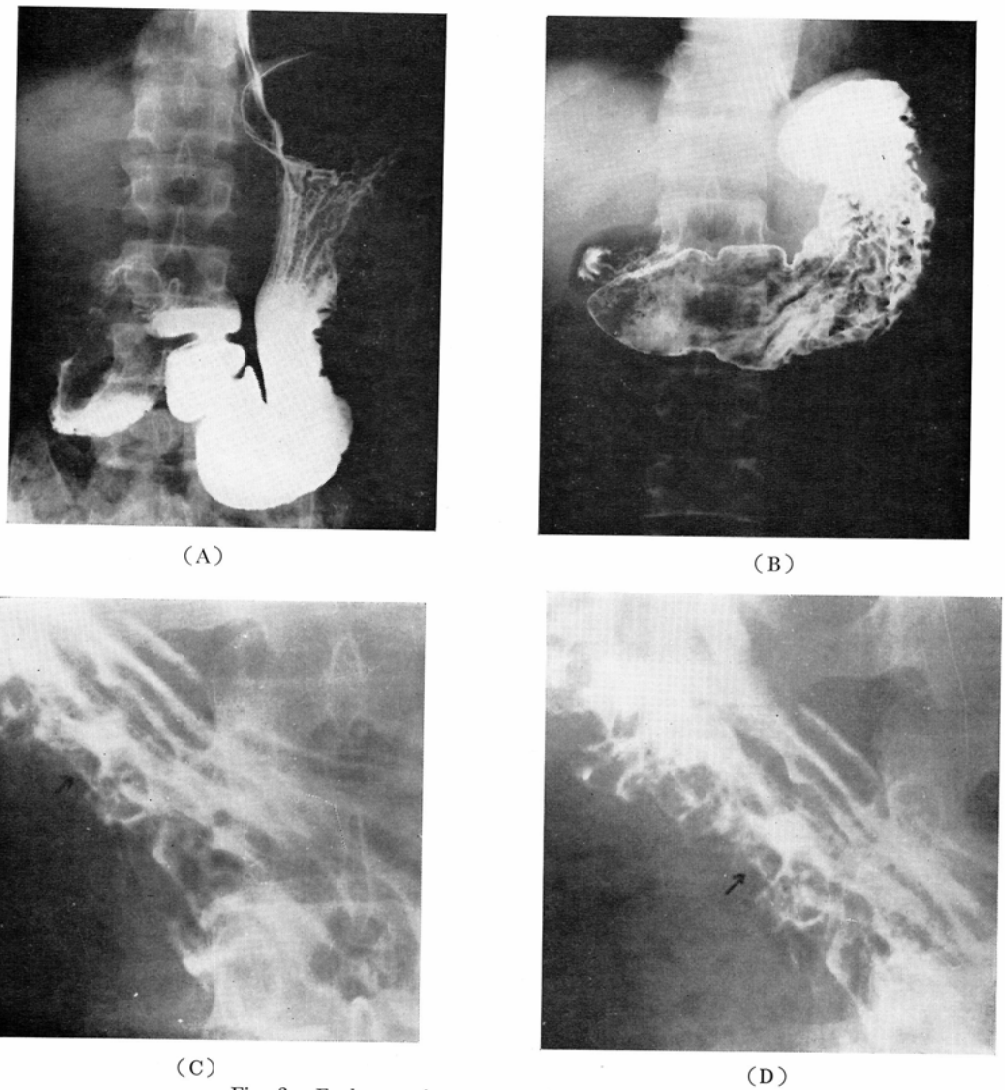
In regard to effects of pretreatment, visualization of the fine relief (gastric area) was unsatisfactory when they were untreated, but satisfactory when they were treated with parasympathetic blocking agents, digestive enzymes, and neutralizers (Fig. 2). Specifically, visualization of the fine relief in various gastric diseases by the double contrast was observed at the rates of 10 to 27% of the cases and the range of the visualization was confined to a part of the gastric antrum. After the pretreatment, however, it was demonstrated at high frequencies of 46 to 75% of the cases and the range was extended to the corpus from the antrum. Furthermore, by the combined application of the pretreatment and the changing position, it was

clearly found at high rates of 70 to 88% of the cases.

Comparison of the technique for the pretreated cases revealed the following:

1. In 9 cases of early gastric cancer:

In 9 cases including 10 early cancer lesions, the mucosal technique with a small amount of barium (20 to 50 cc.) could disclose only 4 of the 10 lesions. The compression technique with a small or moderate amount of barium (20 to 200 cc.) disclosed 8 lesions of the protruding and concaving types effectively, but failed to find 2 lesions with superficial or slight concaving small lesion. These were disclosed by the double contrast technique.



(A) (B)

(C) (D)

Fig. 3. Early gastric cancer: Anterior wall lesion
A. Barium filled stomach: Lesion is invisible
B. Supine double contrast: Lesion is invisible
C and D. Prone position: An anterior wall lesion is clearly demonstrated.

The supine double contrast technique (air 300 cc., barium 200 cc.) succeeded to visualize 9 lesions, but failed to find an anterior wall lesion. This was discovered by the compression technique and the prone double contrast technique, using about 300 cc. of air and 20 to 50 cc. of barium. Generally an excellent double contrast study of the stomach was obtained by means of a greater degree of rotation of the patient, such as Fig. 1B to E. Generally, anterior wall lesions were clearly demonstrated by the prone double contrast, but they were not visualized by the supine double contrast (Fig. 3). However, by the combined application of the double contrast and this rotation, the anterior lesions were distinctly observed (Fig. 4).

When the stomach was filled with barium (200 to 300 cc.), only 4 of the 10 lesions (relatively large in size or situated near the lesser and greater curvatures) were recognized as filling defects or niches, and another 2 lesions showed abnormal contour. When the lesion was small or situated away from the curvatures, it could not be discovered by this technique (Fig. 3, 4).

(A)

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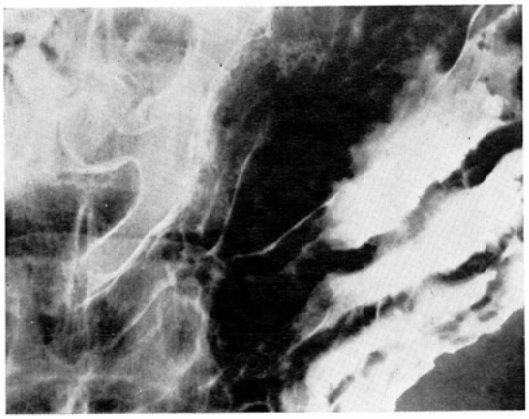

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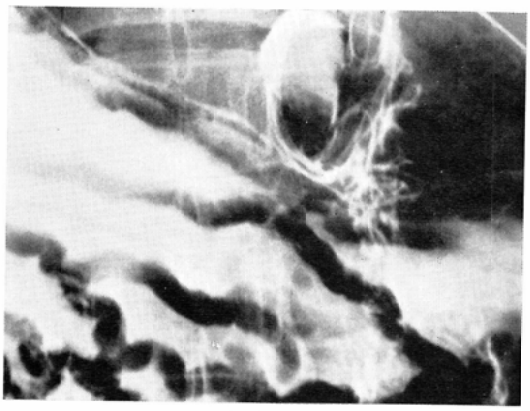

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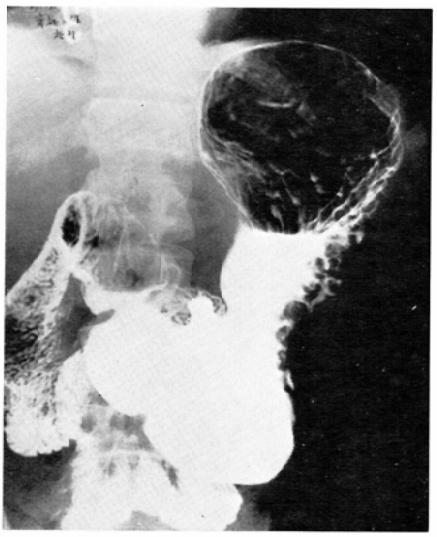
Fig. 4. Early gastric cancer: Anterior wall lesion (Pretreated)
A. Barium-filled stomach: The lesion is invisible.
B. Gastroscopic picture: The lesion is seen on the anterior wall.
C and D. Prone double contrast: An arrow indicates the lesion
E and F. Supine double contrast: The anterior wall lesion is clearly visualized.



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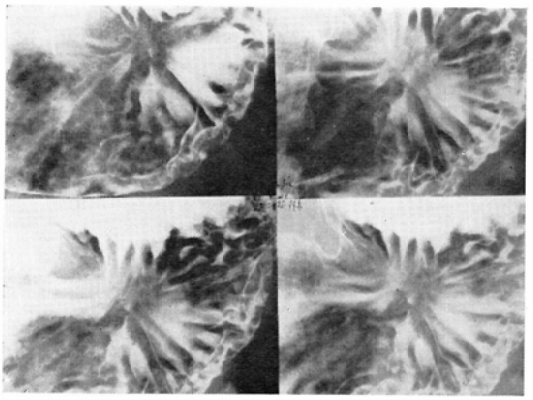

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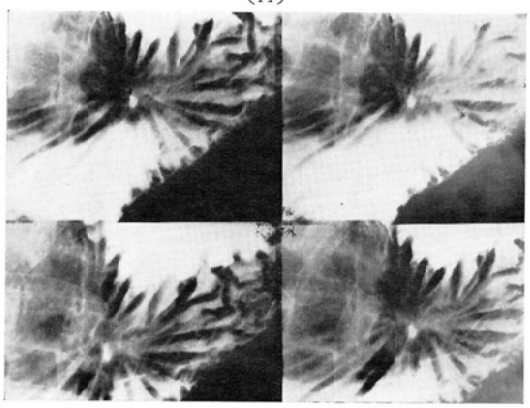

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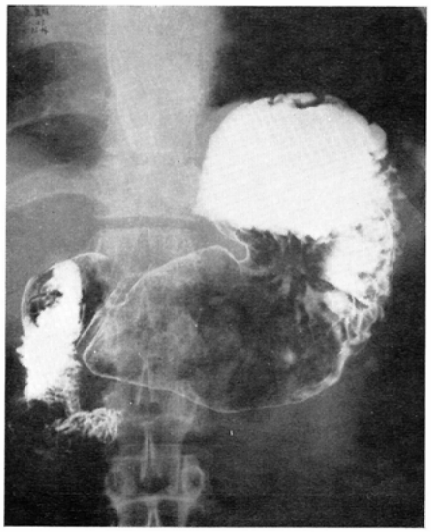

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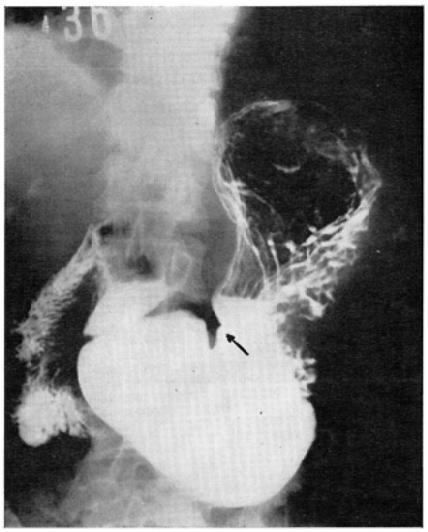

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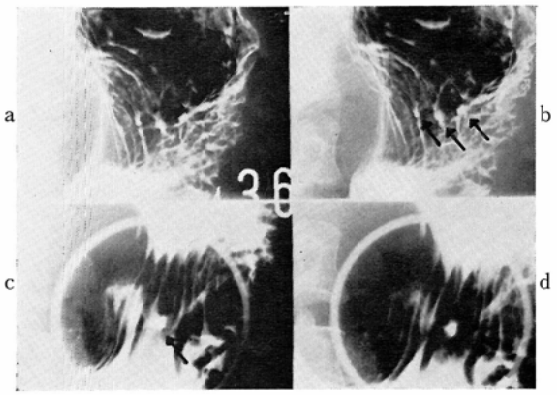

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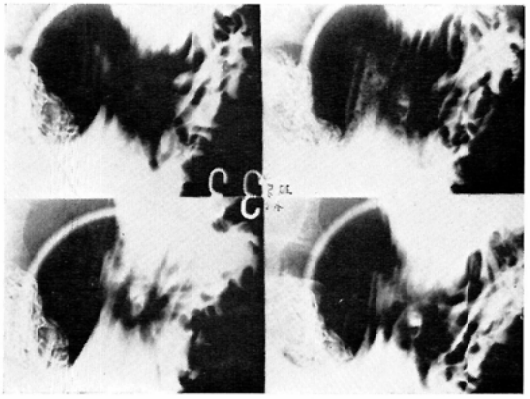

(H)

Fig. 5. Peptic ulcers.

A. Barium filled stomach: Lesions are invisible
B. Supine double contrast combined with positioning: A benign ulcer is clearly visible.
C. Supine double contrast (Standard): In regard to visualization of mucosal folds, B is better, than C.
D. Combined application of supine double contrast with dependent position: The ulcer is clearly visible
E and Fa, b. Erect double contrast: Futhermore, small ulcers of the upper gastric portion are clearly visible (indicated by arrows). Stereographically, these lesions are located on the anterior wall (Fa, b)
G. Barium filled stomach. The lesions are invisible.
Fc, d and H. Compression technique: An ulcer of the body is clearly visible, but for upper gastric ulcers impossible to verify.

2. In 16 cases of small gastric ulcer:

In 16 cases including 24 small lesions, the mucosal technique with a small amount of barium could disclose only 9 of the 24 lesions.

The compression technique with a small or moderate amount of barium disclosed 19 of the 24 lesions. The 5 lesions of the fundus and upper body of the stomach were impossible to verify by means of this technique.

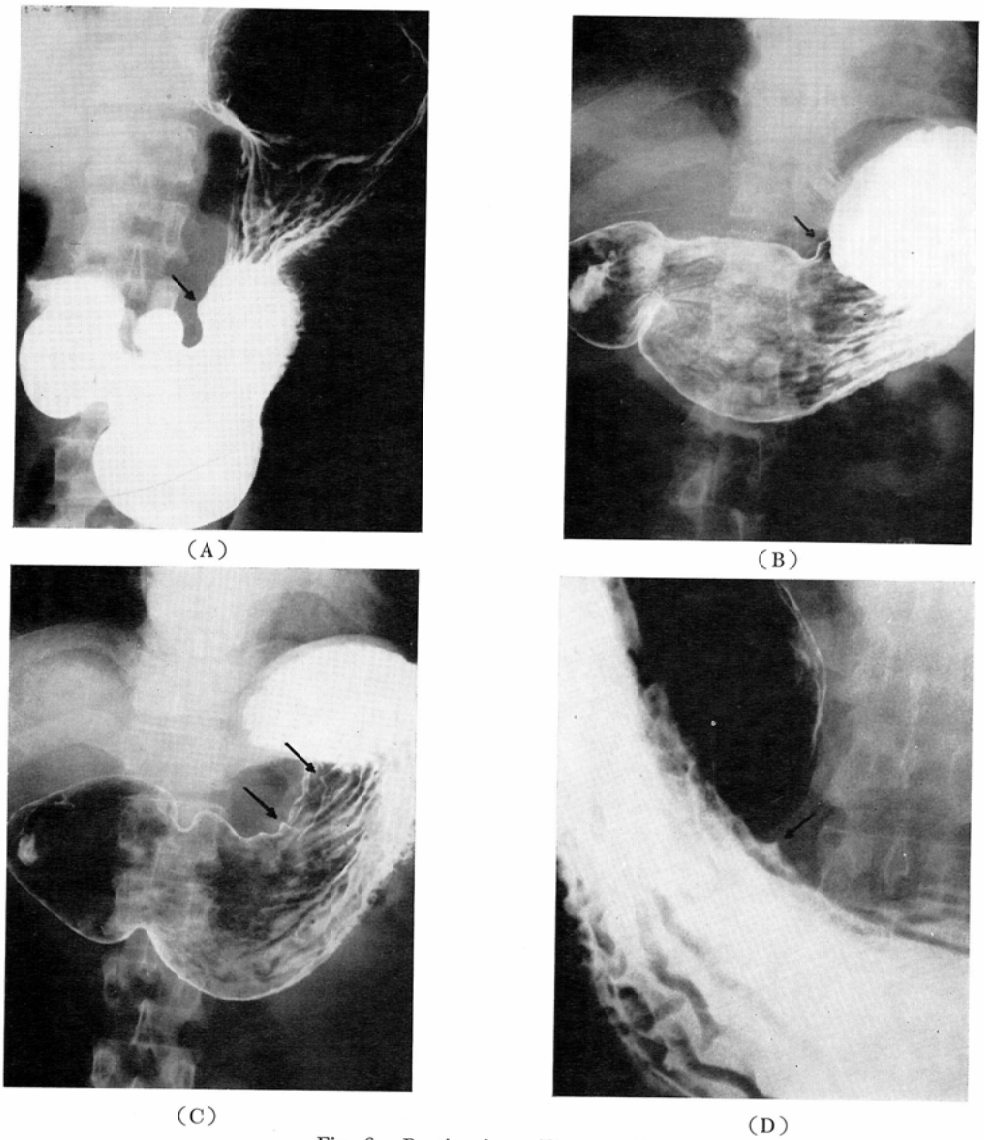

Fig. 6. Peptic ulcers (Pretreated)

A. Barium filled stomach: A lesion is suggested.
B. Supine double contrast combined with positioning: A small niche is clearly visible (arrow).
C. Combined application of Trendelenburg position: Two small ulcers are clearly visible (arrows).
D. Prone double contrast: A small niche is clearly visible (arrow).

Four of these 5 lesions of the upper portion were distinctly demonstrated by the erect double contrast technique and the lesions were clearly shown on the anterior wall by stereoradiography (Fig. 5). The supine double contrast technique succeeded to visualize 19 of the 21 posterior wall lesions. For the demonstration of the upper gastric lesion the dependent position was used, if necessary. The supine double contrast with the Trendelenburg position was useful to demonstrate small ulcers of the upper portion of the stomach (Fig. 6), and the prone double contrast was also valuable for the diagnosis of small lesions.

When the stomach was filled with barium, only 8 of the 24 lesions were recognized as niches, which were located on the lesser curvature. When the lesions were located away from both curvatures, they could not be discovered by this technique.

3. In 3 cases of small gastric polyp:

The mucosal technique with a small amount of barium could disclose only 1 of the 3 lesions.

The compression technique with a small or moderate amount of barium disclosed 2 of the 3 lesions, but a lesion of the cardia could not be found. This lesion was clearly demonstrated by the erect double contrast technique.

The supine double contrast technique succeeded to visualize a total of 3 lesions.

In the barium filled stomach, only 1 of the 3 lesions were recognized as a filling defect, which was located on the lesser curvature. Another 2 lesions which were located away from both curvatures could not be discovered by this technique.

4. In 2 miscellaneous diseases:

A small protruding benign lesion of the cardia was clearly shown by the erect double contrast technique, combined with stereoradiography (Fig.7).

In a case of postogastrectomy, the double contrast of the duodenum was obtained by means of the su-

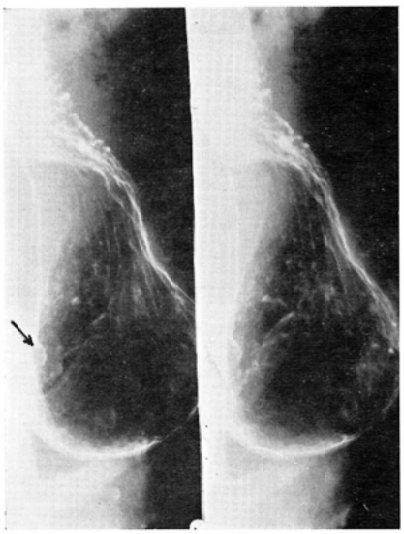

Fig. 7. A small protruding lesion of the cardia (Pretreated): Erect double contrast combined with stereoradiography, which can be seen from the X-ray focus side.

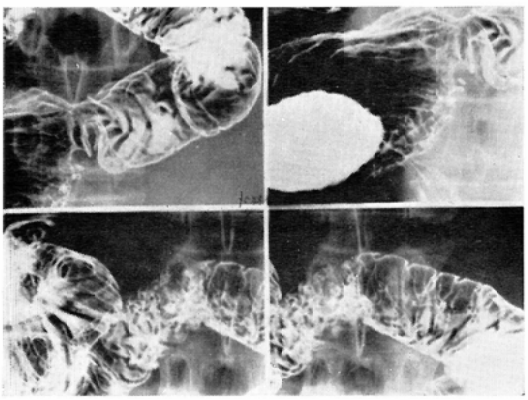

Fig. 8. Postogastrectomy (Pretreated) Double contrast of the duodenum: Double contrast combined with Trendelenburg position and elevating the right side.

pine double contrast, combined with the Trendelenburg position and elevation of the right side (Fig. 8).

Discussion

As for the X-ray techniques, the mucosal folds with a small amount of barium was generally unsatisfactory, as described in our first report (Saito et al., 1966a), due to the fact that this technique is most likely to be affected by hypersecretion, hyperacidity, mucus and necrotic substance, and, furthermore, the insufficient distension of the stomach (Aoyama 1961). Therefore, this is difficult to diagnose the early and small lesions.

The roentgenogram of the barium filled stomach failed to find small lesions or those away from the lesser and greater curvature, nor could it tell the size, form and extension of the lesion (Saito et al., 1964, 1965, 1966a, 1969).

In contrast with this, the double contrast and the compression technique demonstrated themselves valuable in the diagnosis. However, the compression technique was impossible to verify the lesion of the fundus and the upper body of the stomach. While, the combined application of the double contrast, positioning, and pretreatment showed the best results for the demonstration of the early or small lesions.

In regard to the effect of the pretreatment with parasympathetic blocking agents, digestive enzymes and neutralizers, in pretreated cases the visualization of the lesions was generally satisfactory, while in cases without pretreatment unsatisfactory (Saito et al., 1965, 1966a), and the fine relief was highly demonstrated in the antrum and body of the stomach by the pretreatment (Saito et al., 1966a).

In regard to the amount of air and barium in the supine double contrast technique, about 200 to 300 cc. of air and 200 cc. of barium seem to be most suited, and in the prone double contrast technique, about 200 to 300 cc. of air and 20 to 50 cc. of barium seem to be most adaptable (Saito et al. 1966a, 1969).

Generally for the demonstration of the posterior wall lesion of the stomach, the supine double contrast was used, and for the anterior lesion, the prone double contrast was employed.

Also, for a more precise study of the lesion, the positioning of the patient is necessary. For the diagnosis of the posteior wall lesion by the supine double contrast, the patient is rolled repeatedly into the different oblique or lateral positions through the supine position as shown in Fig. 1B. For the demonstration of the anterior wall lesions by the supine double contrast, it is necessary to turn the patient into the different oblique or lateral position through the prone position such as Fig. 1C. And in the diagnosis of anterior and posterior wall lesions at the same time, the combined application of the supine double contrast, pretreatment, and positioning (Fig. 1D) was highly valuable. Some parts of the studies on the stereography were already reported by the authors (Tobe et al., 1966; Saito et al., 1966b; Toda and Tobe, 1967).

For the lesion of the fundus or the upper body of the stomach, the erect double contrast was very useful, furthermore, the combined application of this technique and stereoradiography was highly valuable as shown in Fig. 5 F and 7. Also, for the upper lesion, face-on demonstration in the dependent position was used, if necessary (Schatzki and Gray, 1958).

The duodenal double contrast was first described by Hampton (1937) and then by Templeton et al. (1938). In detecting the duodenal lesion this technique was essential, for the duodenal bulb was unable to compress in 15 to 25% of the patients (Sosman, 1949; Meyer, 1952). Recently, hypotonic duodeno-

graphy has been used (Bilbao et al., 1967).

Summary

Roentgenography was first made without any pretreatment. Then, in order to make the barium stick more intimately to the lesion, parasympathetic blocking agents, digestive enzymes, neutralizers were given for 4 consecutive days and on the morning of the 5th day, 15 minutes prior to roentgenography, 20 to 40 mg. of Buscopan (hyoscin-N-butylbromide) was intramusculary injected.

Concerning the results of the mucosal relief studies, the double contrast was first valuable for the diagnosis of early or small lesions. Next the compression technique was useful, but this technique was impossible to verify the lesion of the upper portion of the stomach or superficial type lesion. The mucosal technique with a small amount of barium was generally unsatisfactory. The roentgenogram of barium filled stomach failed to find small lesions or lesions away from the lesser and greater curvatures.

Regarding the amount of air and barium in the supine or erect double contrast technique, about 200 to 300 cc. of air and 200 cc. of barium showed a satisfactory result, and in the prone double contrast technique, about 200 to 300 cc. of air and 20 to 50 cc. of barium gave a good result.

For more detailed study of the lesion, the combined use of the double contrast, pretreatment and positioning of the patient was necessary. Visualization of the fine relief in various gastric disease by the double contrast was observed at the rate of 10 to 27% and the range of the visualization was confined to a part of the gastric antrum. After the pretreatment, however, it was demonstrated at high frequencies of 46 to 75% and the range was extended to the corpus from the antrum. Furthermore, by the combined application of the pretreatment and positioning, it was clearly found at high rates of 70 to 88% of the cases.

Methods of the positioning of the patient are as follows: For the diagnosis of the posterior wall lesion by the supine double contrast, the patient was repeatedly rolled into the different oblique or lateral position through the supine position. For the anterior lesion, the prone double contrast was used. For the demonstration of the anterior lesion by the supine double contrast, it was necessary to turn the patient into the different oblique or lateral position through the prone position.

In the diagnosis of anterior and posterior wall lesions at the same time, the combined application of the supine or erect double contrast technique, pretreatment, positioning and stereoradiography has resulted in excellent visualization of the early or small lesions.

References

1) Amplatz, K.: Radiology 70: 392—394, 1958.
2) Aoyama, D.: Medicine 18: 472, 1961 (In Japanese)
3) Arens, R.A. and S.D. Mesirow: Radiology 29: 1—11, 1937.
4) Baastrup, C.J.: Acta Radiol. 3: 180—204, 1924.
5) Berg, H.H.: Röntgenuntersuchungen am Innenrelief des Verdauungskanals. 1930. Georg Thieme, Leipzig.
6) Berg, H.H.: Münch. med. Wschr. 92: 31—43, 1950.
7) Bilbao, M.K., Frische, L.H., Dotter, C.T. and J. Rösch: Radiology 83: 438—443, 1967.
8) Bücker, J.: Fortschr. Röntgenstr. 63: 1—28, 1941.
9) Bücker, J.: Die Diagnose des kleinen Magenkrebses. 1944. Springer, Berlin.
10) Chaoul, H.: Deutsche Ztschr. f. Chir. 214: 351—386, 1929.
11) Colcher, A.E.: Radiology 29: 615—620, 1937.
12) Eiken, M.: Acta Radiol. 49: 96—104, 1958.

13) Elischer, J.: Fortschr. Röntgenstr. 18: 332—340, 1911.
14) Foti, M.: Brit. J. Radiol. 36: 407—414, 1963.
15) Frik, W.: Fortschr. Röntgenstr. 88: 546—559, 1958.
16) Gutmann, R.A.: Le diagnostic radiologique precoce du cancer de l'estomac. Deuxiéme Congrés International de Gastroenterologie, Paris, 1937.
17) Gutmann, R.A.: Le diagnostic du cancer d'estomac à la période utile. 1956. G. Doin et Cie, Paris.
18) Hampton, A.O.: Am. J. Roentgenol. 38: 565—570, 1937.
19) Hilpert, F.: Fortschr. Röntgenstr. 38: 80—87, 1928.
20) Holzknecht, G.: Berlin. klin. Wschr. 48: 158—164, 1911.
21) Ichikawa, H., Yamada, T. and H. Doi: Practice in X-ray Diagnosis of the stomach. 1964. Bunkodo, Tokyo. (In Japanese)
22) Konjetzny, G.E.: Zur Früdiagnose des Magenkrebses. II Intern. Congress of Gastroenterology, Paris, 1937.
23) Meyer, R.: Radiology 58: 393—400, 1952.
24) Prévôt, R.: Zur Frudiagnose des Magenkrebses. II Iner. Congress of Gastroenterology, Paris, 1937.
25) Prévôt, R.: The small Gastric Cancer. In Schinz, H.R. et al. Editors: Roentgen-Diagnostics. American Ed. Progress Volume I p. 392—402, 1958 Grune & Stratton, New York and London.
26) Rendich, R.A.: Am. J. Roentgenol. 10: 526—537, 1923.
27) Ruzicka, F.F. and L.G. Rigler: JAMA. 145: 696—702, 1951.
28) Saito, S., Tobe, T., Kato, T. Kikuchi, S., Hirai, E. and S. Niizuma: Presented at Gunmaigaku General Meeting, 1964.
29) Saito, S.: Presented at the 47 and 48 Kitakantoigaku Regular Meeting, Dec. 1964 and Feb. 1965.
30) Saito, S., Tobe, T., Kato, T., Kikuchi, S. and E. Hirai: Nippon Acta Radiologica (Abstract in Japanese) 25: 603—604, 1965.
31) Saito, S., Toda, N. and M. Ishimoto: Gunma J. Med. Sci. 15: 1—16, 1966a.
32) Saito, S., Tobe, T., Toda, N. and M. Ishimoto: Clinical Symposium on Diagnosis of the Upper Gastric Lesion. The 3rd Autumn Congress of Japanese Society of Roentgenology, at Matsumoto, Oct. 1966b.
33) Saito, S., Toda, N., Ishimoto, M., Matsumoto, M., Yamashina, K. and T. Tobe: Gunma J. Med. Sci. 17: 18: 31—40, 1969.
34) Schatzki, R. and J.E. Gray: Am. J. Roentgenol. 79: 772—780, 1958.
35) Shirakabe, H., Kumakura, K., Nakajima, T., Nishizawa, M., Horikoshi, H., Higurashi, K. and R. Koyama: Rinshohoshasen 4: 54—75, 1959. (In Japanese)
36) Shirakabe, H., Ichikawa, H., Kumakura, K., Nishizawa, M., Higurashi, K., Hayakawa, H. and T. Murakami: Atlas of X-ray Diagnosis of Early Gastric Cancer. 1966. Igaku-shoin, Tokyo.
37) Sosman, M.C.: Radiology 52: 810—815, 1949.
38) Templeton, F.E., Marcovich, A.W. and T.E. Heinz: JAMA. 111: 1807—1813, 1938.
39) Tobe, T., Saito, S., Toda, N., Sato, S., Hatori, N. and M. Ishimoto: Gunma J. Med. Sci. 15: 23—31, 1966.
40) Toda, N. and T. Tobe: Nippon Acta Radiologica 27: 391—405, 1967.