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Pathophysiological Studies of the Stomach and Duodenum 2. Comparison Between Peptic Ulcer Group and Control Group

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ABSTRACT. It was examined radiographically whether antro-duodenal motility may be influenced by the existence of malrotation of the duodenal loop (MD) or not. Subjects were divided into 97 cases of the gastric ulcer group and 91 cases of the duodenal ulcer group against 94 cases of the control group. Ulcer cases were further subdivided into two stages of open and scar, respectively. The results were as follows :

1. The appearance of MD was noted with higher incidence in the duodenal ulcer group, especially at the open stage.
2. In the duodenal ulcer group, MD was found with higher frequency at the pars superior, while in the other 2 groups, MD was noted more at the pars descendens.
3. In the duodenal ulcer group, acceleration of antro-duodenal motility was noted, in particular being stronger in the MD group than in the normal group. This tendency was found to be stronger at the open stage than at the scar stage.

In the previous paper, it was reported that torsion anomaly of the duodenal loop (hereafter to be abbreviated as MD) was observed in 19.1% of healthy subjects, and that in these cases the maximum diameter of the duodenum was larger than that in the control group.

In the present paper, this situation was examined with the gastric ulcer group and duodenal ulcer group, particularly centering the viewpoint to the significance of the existence of MD in these ulcer diseases.

Incidentally, fundamental studies on these points have been done by a group of Danish researchers. According to their findings, torsion anomaly was noted in high incidence over the whole length of the duodenal loop, beginning from the bulbus duodeni and ending in the flexura duodeno-jejunalis, and the rate of appearance reached over 40%, especially in juvenile subjects, decreasing, however, when subjects reached an age of over 35[1]. It was also reported[2] that in the cases of duodenal ulcer in these subjects for which operation was received, the retrospective re-examinations of preoperative X-ray pictures revealed anomaly in high incidence, together with distension of the maximum diameters of the

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duodenum and prolongation of the gastric emptying time. Furthermore, it was reported[3] that in patients with dyspepsia the X-ray pictures of whom showed no contributory changes, anomaly of the duodenal loop was detected, and that the determination of the internal pressures of the duodenum in the anomaly group revealed an apparent increase not only in the basal pressure, but also the internal pressures 30 and 50 minutes after a meal, as compared with the control group[4].

With these reports in mind, the author has been examining what association MD has among ulcer diseases. However, the present study has been limited to the morphological examination of X-ray pictures, and other symptomatological problems have been deferred for later investigation. Among the various items concerning the X-ray pictures, the important ones in the studies of Shinohara[5,6], were followed by the author.

SUBJECTS AND METHODS

Subjects : X-ray pictures and endoscopic findings on the upper digestive tracts of patients in the group with gastric ulcer at the open stage (to be abbreviated as GU), gastric ulcer at the scar stage (to be abbreviated as GS), duodenal ulcer at the open stage (to be abbreviated as DU) and duodenal ulcer at the scar stage (to be abbreviated as DS), were used. Patients of gastro-duodenal coexisting ulcers were excluded from the present study.

The age distribution for each group is shown in Table 1.

Methods : The conditions for taking X-ray pictures of upper digestive tracts and the determination methods thereof were made the same as in the previous study[7], the following 5 items being compared and examined :

1. Malrotation of the duodenum (MD)
2. The largest luminal diameters of the duodenum
3. Antral peristalsis (AP)
4. Antral spasm (AS)
5. Duodenal longitudinal folds (Lf)

RESULTS

1. Frequency of the appearance of malrotation

1-1. Frequency and sex ratio : It was decided that the comparison of sex ratio should not go into deep detail, since the number of female subjects was few. Table 1 shows the number of cases classified by age. Comparison of the total in each group revealed that the frequency was significantly high in the duodenal ulcer group, as shown in Table 2.

Comparison of the MD appearance rates in ulcer groups classified by stage showed that MD appeared in high incidence at the open stage of the duodenal ulcer group, as indicated in Table 3.

Comparison of the MD appearance rates classified by sex showed that in total there were no significant differences between the sexes both

TABLE 1. Frequency of Malrotation of the Duodenum related to Age

	Age	16—20	21—30	31—40	41—50	51—60	61—70	71—80	Total
Control group	Normal	0	1	9	26	39	1	0	76
	MD (+)	0	0	3 (25.0)	6 (18.8)	9 (18.8)	0	0	18 (19.1)
GU	Normal	2	7	4	4	12	7	4	40
	MD (+)	0	1 (12.5)	2 (33.3)	2 (33.3)	4 (25.0)	1 (12.5)	2 (33.3)	12 (23.1)
GS	Normal	0	1	11	5	9	6	4	36
	MD (+)	0	1 (50.0)	2 (15.4)	2 (28.6)	1 (10.0)	2 (25.0)	1 (20.0)	9 (20.0)
DU	Normal	1	8	4	6	2	1	0	22
	MD (+)	1 (50.0)	5 (38.5)	8 (66.7)	5 (45.5)	5 (71.4)	2 (66.7)	1 (100.0)	27 (55.1)
DS	Normal	4	5	4	9	6	4	0	32
	MD (+)	1 (20.0)	2 (28.6)	2 (33.3)	2 (18.2)	1 (14.3)	1 (20.0)	1 (100.0)	10 (23.8)

Normal : Normal duodenal configuration
MD (+) : Malrotation of the duodenum
GU : open stage of gastric ulcer
GS : scar stage of gastric ulcer
DU : open stage of duodenal ulcer
DS : scar stage of duodenal ulcer
( ) : percentage

TABLE 2. Appearance of MD (Total)

		Normal Duodenal Configuration	Malrotation of the Duodenum	Total
Control Group		76 (80.9)	18 (19.1)	94 (100.0)
Ulcer Group	Gastric	76 (78.4)	21 (21.6)	97 (100.0)
	Duodenal	54 (59.3)	37 (40.7)**	91 (100.0)

**.....$P<0.01$ Probability difference was evaluated to the control group, hereafter.

TABLE 3. Appearance of MD (by Stage)

			Normal Duodenal Configuration	Malrotation of the Duodenum	Total
Control Group			76 (80.9)	18 (19.1)	94 (100.0)
Ulcer Group	Gastric	GU	40 (76.9)	12 (23.1)	52 (100.0)
		GS	36 (80.0)	9 (20.0)	45 (100.0)
	Duodenal	DU	22 (44.9)	27 (55.1)**	49 (100.0)
		DS	32 (76.2)	10 (23.8)	42 (100.0)

**.....$P<0.01$

in the gastric ulcer group and duodenal ulcer group. However, markedly higher rates were observed in the duodenal ulcer group in both sexes, as compared with the gastric ulcer group (Table 4).

In the duodenal ulcer group in particular, MD was noted in far higher rates at the open stage than at the scar stage when classified by both the stage and sex ratio (Table 5).

TABLE 4. Appearance of MD of sex ratio (Total)

		Male		Female		Total	
Control Group		18/92	(19.6)	0/ 2	(—)	18/94	(19.1)
Ulcer Group	Gastric	14/65	(21.5)	7/32	(21.9)	21/97	(21.6)
	Duodenal	27/67	(40.3)	10/24	(41.7)	37/91	(40.7)

TABLE 5. Appearance of MD of sex ratio (by Stage)

			Male		Female		Total	
Control Group			18/92	(19.6)	0/ 2	(—)	18/94	(19.1)
Ulcer Group	Gastric	GU	10/38	(26.3)	2/14	(14.3)	12/52	(23.1)
		GS	4/27	(14.8)	5/18	(27.8)	9/45	(20.0)
	Duodenal	DU	18/34	(52.9)	9/15	(60.0)	27/49	(55.1)
		DS	9/33	(27.3)	1/ 9	(11.1)	10/42	(23.8)

1-2. Frequencies classified by the site of appearance and by the degree of MD : Table 6 shows the MD appearance rates, classified by position and grade. Comparison of the total in each group revealed that MD was found more at the pars descendens in the control group and gastric ulcer group, whereas it was found markedly more at the pars superior in the duodenal ulcer group (Table 7).

2. The maximum diameters of the duodenum

The maximum diameters of the duodenum classified by group were compared between the normally shaped group and MD group. It was found that the diameter distending tendency was noted in the latter group.

A diameter distending tendency was observed more in the scar stage than in the open stage for both ulcer groups, and the tendency was significantly high in the MD group for duodenal ulcer (Table 8).

3. The total rates of appearance of AP, Lf and AS

3-1. Appearance of AP : The following results were obtained for AP appearance rates for the total of each of the control group, gastric ulcer group and duodenal ulcer group : The results for the gastric ulcer group were not very different from those for the control group, while

TABLE 6. The Position and the Grade of Malrotation of the Duodenum

		Pars Superior	Pars Descendens	Pars Horizontalis	Total
Control group	Severe	0	3 (16.7%)	0	3 (16.7%)
	Mild	1 (5.6%)	7 (38.9%)	0	8 (44.4%)
	Normal variant	6 (33.3%)	1 (5.6%)	0	7 (38.9%)
	Total	7 (38.9%)	11 (61.1%)	0	18 (100.0%)
GU	Severe	1 (8.3%)	0	0	1 (8.3%)
	Mild	0	10 (83.3%)	0	10 (83.3%)
	Normal variant	1 (8.3%)	0	0	1 (8.3%)
	Total	2 (16.7%)	10 (83.3%)	0	12 (100.0%)
GS	Severe	0	0	0	0
	Mild	3 (33.3%)	5 (55.6%)	1 (11.1%)	9 (100.0%)
	Normal variant	0	0	0	0
	Total	3 (33.3%)	5 (55.6%)	1 (11.1%)	9 (100.0%)
DU	Severe	3 (11.1%)	3 (11.1%)	0	6 (22.2%)
	Mild	15 (55.6%)	5 (18.5%)	0	20 (74.1%)
	Normal variant	1 (3.7%)	0	0	1 (3.7%)
	Total	19 (70.4%)	8 (29.6%)	0	27 (100.0%)
DS	Severe	0	1 (10.0%)	0	1 (10.0%)
	Mild	8 (80.0%)	1 (10.0%)	0	9 (90.0%)
	Normal variant	0	0	0	0
	Total	8 (80.0%)	2 (20.0%)	0	10 (100.0%)
Total	Severe	4 (5.3%)	7 (9.2%)	0	11 (14.5%)
	Mild	27 (35.5%)	28 (36.8%)	1 (1.3%)	56 (73.7%)
	Normal variant	8 (10.5%)	1 (1.3%)	0	9 (11.8%)
	Total	39 (51.3%)	36 (47.4%)	1 (1.3%)	76 (100.0%)

TABLE 7. Frequencies Classified by the Position of Appearance of MD (Total)

		Pars Superior	Pars Descendens	Pars Horizontalis	Total
Control Group		7 (38.9)	11 (61.1)	0 (—)	18 (100.0)
Ulcer Group	Gastric	5 (23.8)	15 (71.4)	1 (4.8)	21 (100.0)
	Duodenal	27 (73.0)*	10 (27.0)*	0 (—)	37 (100.0)

*.....$P<0.05$

those for the duodenal ulcer group showed markedly high rates as compared with those of the control group. Comparison of these results for the normal group and MD group revealed the following : With gastric ulcers, the AP appearance rates were declining in the MD group, whereas with duodenal ulcers, higher rates were recorded in the MD group. In the MD group, with duodenal ulcers in particular, specifically higher rates than those in the control group appeared, followed by the normal group. On the other hand, with gastric ulcers the MD group showed rates lower than those of the control group (Table 9).

TABLE 8. The Largest Luminal Diameter of the Duodenum

	Normal duodenal configuration			Malrotation of the duodenum		
	Diameter (mm)			Diameter (mm)		
	n	Range	Mean±SD	n	Range	Mean±SD
Control group	76	15–37	24±5.21	18	20–35	27±4.38
GU	40	17–41	26±6.07	12	18–45	28±7.79
GS	36	18–45	27±6.32	9	18–35	29±5.64
DU	22	17–42	25±6.55	27	18–38	26±5.29
DS	32	17–40	26±5.02	10	23–40	31±5.29

TABLE 9. Appearance of AP (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		21/76	(27.6)	6/18	(33.3)	27/94	(28.7)
Ulcer Group	Gastric	25/76	(32.9)	5/21	(23.8)	30/97	(30.9)
	Duodenal	18/54	(33.3)	19/37	(51.4)	37/91	(40.7) +

+……P<0.10

Comparison of ulcers classified by stage indicated a higher tendency of appearance rates in the open stage than in the scar stage, both in the normal and MD groups, with duodenal ulcers as well as with gastric. On the other hand, comparison of the normal and MD groups classified by stage showed that in gastric ulcers the AP appearance rates were higher in the normal group than in the MD group at both open and scar stages, while with duodenal ulcers the rates were significantly higher in the MD group than in the normal group at either stage (Table 10).

TABLE 10. Appearance of AP (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			21/76	(27.6)	6/18	(33.3)	27/94	(28.7)
Ulcer Group	Gastric	GU	14/40	(35.0)	4/12	(33.3)	18/52	(34.6)
		GS	11/36	(30.6)	1/ 9	(11.1)	12/45	(26.7)
	Duodenal	DU	8/22	(36.4)	15/27	(55.6)	23/49	(46.9)*
		DS	11/32	(34.4)	4/10	(40.0)	15/42	(35.7)

*……P<0.05

3–2. Appearance of Lf : The Lf appearance rates in the total of each group were as follows : The Lf appearance rates with gastric ulcers were lower than those in the control, but higher with duodenal ulcers. Further

comparison based on the existence or non-existence of MD revealed the following : With gastric ulcers, the Lf appearance rates were lower in the MD group than in the normal group, whereas with duodenal ulcers, the rates were markedly higher in the MD group than in the normal group (Table 11).

Ulcers classified by stage were also compared, and it was found that in gastric ulcers the Lf appearance rates were higher at the scar stage than at the open stage, but that with duodenal ulcers the results were reversed. Further scrutiny into detail was avoided because of the small number of MD group cases, and, limiting the discussion to the normal group alone, it may be suggested that Lf appeared in higher rates at the scar stage than at the open stage, while with duodenal ulcers, the rates were higher at the open stage than at the scar stage. Similar findings were obtained in the MD group with duodenal ulcers (Table 12).

TABLE 11. Appearance of Lf (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		15/76	(19.7)	5/18	(27.8)	20/94	(21.3)
Ulcer Group	Gastric	9/76	(11.8)	2/21	(9.5)	11/97	(11.3)+
	Duodenal	13/54	(24.1)	19/37	(51.4)*	32/91	(35.2)*

*…P<0.05 +……P<0.10

TABLE 12. Appearance of Lf (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			15/76	(19.7)	5/18	(27.8)	20/94	(21.3)
Ulcer Group	Gastric	GU	2/40	(5.0)*	2/12	(16.7)	4/52	(7.7)*
		GS	7/36	(19.4)	0/ 9	(—)	7/45	(15.6)
	Duodenal	DU	7/22	(31.8)	15/27	(55.6)+	22/49	(44.9)**
		DS	6/32	(18.8)	4/10	(40.0)	10/42	(23.8)

**…P<0.01 *…P<0.05 +…P<0.10

3-3. Appearance of AS : The AS appearance rates in the total of each of the control, gastric ulcers and duodenal ulcers,were examined, and the following results were obtained : AS appeared in higher rates with gastric ulcers and duodenal ulcers than in the control. Comparison between these ulcers revealed that the rates were higher with gastric ulcers than with duodenal ulcers.

Comparison based on the existence or non-existence of MD indicated that MD in duodenal ulcers was markedly low. In all other cases, however, MD was noted in higher rates in both ulcer types than in the control. The rates were markedly low in the MD group for

duodenal ulcer, as compared with the normal group (Table 13).

Comparison of ulcers classified by stage produced the following results : AS did not appear in the MD group at the scar stage for both ulcer types. Comparison of the MD group at the open stage showed that with gastric ulcers AS was observed in high rates, whereas with duodenal ulcers the rates were lower than those in the control. Further comparison of the open stage and scar stage in the normal group revealed that the AS appearance rates at both stages were higher than those in the control. However, the AS appearance rates at the scar stage became lower than at the open stage for gastric ulcers, while for duodenal ulcers, the rates were markedly higher instead (Table 14).

TABLE 13. Appearance of AS (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		4/76	(5.3)	2/18	(11.1)	6/94	(6.4)
Ulcer Group	Gastric	17/76	(22.4)**	5/21	(23.8)	22/97	(22.7)**
	Duodenal	10/54	(18.5)*	2/37	(5.4)	12/91	(13.2)

**…P<0.01 *…P<0.05

TABLE 14. Appearance of AS (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			4/76	(5.3)	2/18	(11.1)	6/94	(6.4)
Ulcer Group	Gastric	GU	11/40	(27.5)**	5/12	(41.7)+	16/52	(30.8)**
		GS	6/36	(16.7)*	0/ 9	(—)	6/45	(13.3)
	Duodenal	DU	2/22	(9.0)	2/27	(7.4)	4/49	(8.2)
		DS	8/32	(25.0)**	0/10	(—)	8/42	(19.0)*

**…P<0.01 *…P<0.05 +…P<0.10

4. Comparisons of appearance rates among AP, Lf and AS

4-1. Appearance rates among AP, Lf and AS : There was no case where all three of AP, Lf and AS appeared (Table 15).

TABLE 15. Appearance rates among AP, Lf and AS

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			0/76	(—)	0/18	(—)	0/94	(—)
Ulcer Group	Gastric	GU	0/40	(—)	0/12	(—)	0/52	(—)
		GS	0/36	(—)	0/ 9	(—)	0/45	(—)
	Duodenal	DU	0/22	(—)	0/27	(—)	0/49	(—)
		DS	0/32	(—)	0/10	(—)	0/42	(—)

4-2. Appearance rates of two of AP, Lf and AS

i) Appearance rates of AP and Lf : Comparison was made for the totals of the normal group and MD group, and it was found that the rates for gastric ulcers were very similar to those in the control, while with duodenal ulcers the rates were markedly higher. Further comparison was made on the existence or non-existence of MD, and it was found that in gastric ulcers AP and Lf appeared in the normal group alone, and not in the MD group, while with duodenal ulcers, appearance even in the normal group showed higher rates than in the control. In the MD group the rates were still significantly higher (Table 16).

Comparison classified by stage revealed that with gastric ulcers the rates in total were higher at the open stage than at the scar stage, while with duodenal ulcers the rates were higher at the open stage than at the scar stage. On the other hand, Comparison for the existence or non-existence of MD classified by stage indicated that in both ulcer types the rates were higher at the scar stage than at the open stage in the normal group, whereas with duodenal ulcers, the rates were higher at the open stage than at the scar stage in the MD group (Table 17).

TABLE 16. Appearance rates of AP and Lf (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		4/76	(5.3)	1/18	(5.6)	5/94	(5.3)
Ulcer Group	Gastric	5/76	(6.6)	0/21	(—)	5/97	(5.2)
	Duodenal	5/54	(9.3)	8/37	(21.6)	13/91	(14.3)*

*…P<0.05

TABLE 17. Appearance rates of AP and Lf (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			4/76	(5.3)	1/18	(5.6)	5/94	(5.3)
Ulcer Group	Gastric	GU	1/40	(2.5)	0/12	(—)	1/52	(1.9)
		GS	4/36	(11.1)	0/ 9	(—)	4/45	(8.9)
	Duodenal	DU	1/22	(4.5)	7/27	(25.9)+	8/49	(16.3)*
		DS	4/32	(12.5)	1/10	(10.0)	5/42	(11.9)

*…P<0.05 +…P<0.10

ii) Appearance rates of both AS and AP : Appearance of both AP and AS was noted in the normal group alone for gastric ulcers, and not for any of the other groups (Table 18).

TABLE 18. Appearance rates of AP and AS (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			0/76	(—)	0/18	(—)	0/94	(—)
Ulcer Group	Gastric	GU	1/40	(2.5)	0/12	(—)	1/52	(1.9)
		GS	0/36	(—)	0/ 9	(—)	0/45	(—)
	Duodenal	DU	0/22	(—)	0/27	(—)	0/49	(—)
		DS	0/32	(—)	0/10	(—)	0/42	(—)

iii) Appearance rates of both Lf and AS : Appearance of both Lf and AS was not observed in the control. There were only a few cases where this was noted for gastric and duodenal ulcers, and the rates were slightly higher for duodenal ulcers. However, comparison based on the existence or non-existence of MD was avoided because of the small number of case (Table 19).

TABLE 19. Appearance rates of Lf and AS (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			0/76	(—)	0/18	(—)	0/94	(—)
Ulcer Group	Gastric	GU	0/40	(—)	1/12	(8.3)	1/52	(1.9)
		GS	1/36	(2.8)	0/ 9	(—)	1/45	(2.2)
	Duodenal	DU	2/22	(9.0)**	2/27	(7.4)	4/49	(8.2)**
		DS	2/32	(6.3)*	0/10	(—)	2/42	(4.8)*

** · $P<0.01$ *···$P<0.05$

4-3. Appearance rates of only one of AP, Lf or AS

i) Appearance rates of AP only : Comparison of the total revealed that the appearance rates of AP alone were lower for gastric ulcers than in the control, while the rates were higher for duodenal ulcers. Further comparison on the existence or non-existence of MD indicated that the appearance rates were higher in the MD group than in the normal group for either the control, gastric ulcers or duodenal ulcers (Table 20).

TABLE 20. Appearance rates of AP only (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		17/76	(22.4)	5/18	(27.8)	22/94	(23.4)
Ulcer Group	Gastric	19/76	(25.0)	5/21	(23.8)	24/97	(24.7)
	Duodenal	14/54	(25.9)	11/37	(29.7)	25/91	(27.5)

Comparison classified by stage showed that for both ulcer types the rates tended to be lower at the scar stage than at the open stage, which was more marked in the cases of gastric ulcers. Further comparison on the existence or non-existence of MD did not show the difference in the MD group for duodenal ulcers, but in all other groups the rates proved lower at the scar stage than at the open stage (Table 21).

TABLE 21. Appearance rates of AP only (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			17/76	(22.4)	5/18	(27.8)	22/94	(23.4)
Ulcer Group	Gastric	GU	12/40	(30.0)	4/12	(33.3)	16/52	(30.8)
		GS	7/36	(19.4)	1/ 9	(11.1)	8/45	(17.8)
	Duodenal	DU	7/22	(31.8)	8/27	(29.6)	15/49	(30.6)
		DS	7/32	(21.9)	3/10	(30.0)	10/42	(23.8)

ii) Appearance rates of Lf only : Comparison of the total revealed that in gastric ulcers, as compared with the control, the rates were markedly low (Table 22). Further comparison on existence or non-existence revealed that the rates were markedly high in the MD group for duodenal ulcers compared with the control (Table 23).

TABLE 22. Appearance rates of Lf only (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		11/76	(14.5)	4/18	(22.2)	15/94	(16.0)
Ulcer Group	Gastric	3/76	(3.9)*	1/21	(4.8)	4/97	(4.1)**
	Duodenal	4/54	(7.4)	9/37	(24.3)	13/91	(14.3)

**…P<0.01 *…P<0.05

TABLE 23. Appearance rates of Lf only (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			11/76	(14.5)	4/18	(22.2)	15/94	(16.0)
Ulcer Group	Gastric	GU	1/40	(2.5)*	1/12	(8.3)	2/52	(3.8)*
		GS	2/36	(5.6)	0/ 9	(—)	2/45	(4.4)
	Duodenal	DU	4/22	(18.2)	6/27	(22.2)	10/49	(20.4)
		DS	0/32	(—)	3/10	(30.0)	3/42	(7.1)

*…P<0.05

iii) Appearance rates of AS only : Comparison of the total revealed that the rates were markedly higher in gastric ulcers than in duodenal ulcers compared with the control, irrespective of the existence or non-existence of MD (Table 24).

Further comparison was made after the classification of stage, and it was found that the rates were remarkably higher at the open stage than at the scar stage for gastric ulcers, while for duodenal ulcers AS was detected in comparatively higher frequency, although no AS was discovered at the open stage. Comparison was also made on the existence or non-existence of MD, and AS was found more at the open stage both in the normal and MD groups (Table 25).

TABLE 24. Appearance rates of AS only (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		4/76	(5.3)	2/18	(11.1)	6/94	(6.4)
Ulcer Group	Gastric	15/76	(19.7)**	4/21	(19.0)	19/97	(19.6)**
	Duodenal	6/54	(11.1)	0/37	(—)	6/91	(6.6)

**…P<0.01

TABLE 25. Appearance rates of AS only (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			4/76	(5.3)	2/18	(11.1)	6/94	(6.4)
Ulcer Group	Gastric	GU	10/40	(25.0)**	4/12	(33.3)	14/52	(26.9)**
		GS	5/36	(13.9)	0/ 9	(—)	5/45	(11.1)
	Duodenal	DU	0/22	(—)	0/27	(—)	0/49	(—)
		DS	6/32	(18.8)*	0/10	(—)	6/42	(14.3)

**…P<0.01 *…P<0.05

4-4. The cases where neither AP, Lf nor AS was detected

The ratio of the cases where comparison of the total showed neither AP, Lf nor AS was lower for both ulcer groups than for the control, being particularly lower for duodenal ulcers than gastric.

More especially, MD for duodenal ulcers was remarkably low, as compared with the MD group. On the other hand, comparison based on the existence or non-existence of MD in each group indicated no fixed tendency. In duodenal ulcers, however, the ratio was specifically lower in the MD group than in the normal group among duodenal ulcers (Table 26).

These results were compared for examination after classifying them by stage. It was found in both ulcer groups that the ratio was higher

at the scar stage than at the open stage, and that the tendency was more marked in the MD group, for gastric ulcers. Further comparison on the existence or non-existence of MD revealed that the ratio was lower in the MD group than in the normal group, excluding the cases at the scar stage with gastric ulcers (Table 27).

TABLE 26. Cases where neither AP, Lf nor AS was detected (Total)

		Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group		40/76	(52.6)	7/18	(38.9)	47/94	(50.0)
Ulcer Group	Gastric	32/76	(42.1)	10/21	(47.6)+	42/97	(43.3)
	Duodenal	21/54	(38.9)	7/37	(18.9)	28/91	(30.8)*

*…P<0.05 +…P<0.10

TABLE 27. The cases where neither AP, Lf nor AS was detected (by Stage)

			Normal Duodenal Configuration		Malrotation of the Duodenum		Total	
Control Group			40/76	(52.6)	6/18	(33.3)	46/94	(48.9)
Ulcer Group	Gastric	GU	15/40	(37.5)	2/12	(16.7)	17/52	(32.7)+
		GS	17/36	(47.2)	8/ 9	(88.9)**	25/45	(55.6)
	Duodenal	DU	8/22	(36.4)	4/27	(14.8)	12/49	(24.5)**
		DS	13/32	(40.6)	3/10	(30.0)	16/42	(38.1)

**…P<0.01 +…P<0.10

DISCUSSION

In view of the facts that the number of cases in the present study was small, and that classification by stage holds some doubt whether such classification can enable the drawing of a strict boundary line, the author refrained from analyzing the results in minute detail, and limited the discussion to an overall one, examination by stage was conducted only for an outcome considered to have some significance.

First, the most important findings were that the ratios of neither of AP, Lf nor AS was lower in both ulcer types than in the control, that this tendency was stronger in the normal group than in the MD group, and that it was stronger at the scar stage than at the open stage among ulcer cases. The second-most important findings were that comparison between the gastric ulcer group and the duodenal ulcer group revealed that in the former group the ratio of non-existence of AP, Lf and AS, and the AS appearance rate higher, whereas in the duodenal ulcer group the appearance rates of AP, Lf and both AP and Lf together, were high, and that these high appearance rates were remarkable in the MD group, as compared with the gastric ulcer group where no significant

mutual relations between MD and these rates were noted.

These findings suggest the following : Provided that AP, Lf and AS may be regarded as the factors representing antroduodenal motility, the author must consider that the existence of MD has an influence on antroduodenal motility, that particularly in ulcer cases stronger influence must be given at the open stage than at the scar stage, and that the existence of MD must have an important significance.

The rates of the appearance of AP and AS were compared next. It was found that there was an entirely reverse relationship between the gastric and the duodenal ulcer groups. To be more precise, the AS appearance rates were markedly higher than the AP appearance rates in the gastric ulcer group, while in the duodenal group, the reverse was the case. However, investigation into the existence or non-existence of MD revealed no significant difference in the gastric ulcer group, whereas in the duodenal ulcer group significant difference of AP was noted in the MD group, and of AS in the normal group.

These findings suggest that different factors for motility patterns may exist between AP and AS, more so in the duodenal group where the tendency of the higher AP appearance rates and the lower AS appearance rates due to the existence of MD may be worthy of attention.

The author continues the discussion with these findings in mind, and it has been considered that we should not forget that AP and AS are in essence heterogeneous, although they are represented on X-ray pictures as similar contractions of the gastric walls, and that it is improper to regard both as belonging to the same category.

This may be understood if we consider that, while AP is a contraction of the circular muscle corresponding to the greater and lesser curvatures, the majority of AS is caused by the contraction of the muscularis mucosae, although AS cannot completely exclude atypical tonic contraction of the circular muscle. When, however, peristalsis of the stomach draws near the pylorus, tonic changes due to folding by contraction occur in the duodenum. If we consider that this is an overall picture resulting from a state exceeding the inhibitory effect due to internal reflex involved with antral contraction after the contents of the stomach are excreted into the duodenum by peristalsis, and that each individual contracting wave in the duodenum is folded and accelerated[8], these findings are very interesting.

We now come to the question whether the anomaly of the duodenal loop may really produce clinically significant influences or not.

Moellmann et al.[9], summarizing dyspepsia cases, gave the name of "X-ray negative dyspepsia (XND)" thereto since they were unable to prove the causes of the organic changes with X-ray pictures, and compared such cases of ulcers using the venn diagram. They reported that XND is a unit of a heterogeneous disease as compared with ulcer.

Funch-Jensen et al.[10], summarizing cases of diffuse upper abdominal dyspepsia, although failing to prove ulcer with X-ray pictures, named the disorder

"ulcer negative dyspepsia (UND)". They further examined the serum calcitonin levels in UND, before, during, and after meals, and the results were compared with those in duodenal ulcers and normal cases. They came to the conclusion that in UND a specific pattern occurred, unlike in ulcer diseases and normal cases, of increasing the calcitonin values temporarily after the food intake. They therefore renamed UND as XND following the concept of Moellmann et al.[9]

As has been explained so far, XND should be nosographically treated separately, although ulcer was unable to be proved organically. Furthermore, another important finding was added, in that XND seems to be closely associated with the anomaly of the duodenal loop.

Thommesen et al.[3] discovered the anomaly of the duodenal loop in 19 cases of XND among a total of 26, and they further detected some differences in the changes of the serum gastrin levels with 7 normal cases. To be more specific, the serum gastrin levels were not different from those in normal cases in the basal state, while the levels in the cases having abnormal duodenal loops were significantly higher than those in the normal cases, observed 45 minutes, 60 minutes and 120 minutes after meals.

Funch-Jensen et al.[11] divided 22 cases of chronic upper dyspepsia without ulcer disease into 9 cases of normal duodenal loop and 13 cases of abnormal duodenal loop, and gastroesophageal reflux and gastroesophageal sphincter pressure in each group were compared. It was reported that although no difference of sphincter pressure was noted between the two groups, the number of cases where the reflux was positive was only 1 among the total of 9 in the normal group, whereas in the abnormal group the number was as high as 7 cases out of 13.

On the other hand, it was reported symptomatologically[12] that in the cases of abnormal duodenal loops, the symptoms provoked by meals, vomiting, regurgitation, heartburn, and more particularly, by irritable bowl syndrome, appeared in high frequency.

As has been explained so far, a pathophysiologically specific pattern is noted in the cases where duodenal loop anomaly exists, one of the most interesting phenomena among such cases being the problem of gastric emptying.

Thommeson et al.[13], who determined the gastric emptying time for solid foods, reported that they had divided cases of duodenal anomaly by proximal and distal sites, giving the names of proximal duodenal anomaly (PDA) and distal duodenal anomaly (DDA), respectively, in order to compare them with cases of normal duodenal loops, and that the results showed that the mean gastric emptying time in 9 normal cases was 6 hours, whereas that of PDA was shortened to 4.5 hours as against the time of DDA prolonged to 9 hours. It was further discovered that there was positive correlation between the emptying time and the duration of increased serum gastrin secretion, and that the gastrin secretion patterns due to stimulation with foods were the same both in PDA and DDA, but that both showed clearly higher levels, as compared with those

in the normal loop group.

Funch-Jensen et al.[14], concerning movement between the stomach and duodenum after food intake, compared 7 cases of XND, 5 cases of PDA, and 12 cases of DDA, with 8 normal cases, and examined antroduodenal motility, before, during and after food intake, observing that the food-stimulated activity in the DDA group was markedly higher than in any other group, but that no difference was noted in antral motility. This finding was in good accord with the report[13] that the gastric emptying time in the DDA group was prolonged, while in the PDA group it was shortened. This finding was also interesting in consideration of the report[15] that the duodenum regulates gastric emptying, and the report[3] that the delay in the gastric emptying rate observed in the cases of abnormal duodenal loops may be attributed to the increase in gastrin secretion after food intake.

From a different point of view, it may therefore be naturally considered that duodenal loop anomaly must have an influence on the mechanism of transport in the duodenum. If so, it may be a matter of course that this motility anomaly as a vital reaction will occur around the site of anomaly, especially in the proximal region.

Thommesen et al.[4] compared 7 duodenal motility patterns in the DDA group with those of 7 normal loop cases, and came to the conclusion that discordant pressure patterns and pressure waves having significantly higher frequencies were present both in the basal and food-stimulated patterns in the DDA group, as compared with the normal group, evidencing apparently that the anomaly was exerting an influence on the transport mechanism.

Under these circumstances, the difference between XND and abnormal duodenal loop is reduced, and the significantly higher food-stimulated duodenal activity, in addition to abnormal gastrocolic reflex, increased incidence of pyloric regurgitation, disturbed gastric emptying, increased postural duodenal activity, increased serum gastrin secretion and increased incidence of gastroesophageal reflux, all put together, may be cited as grounds against identification of duodenal anomaly with XND[14].

It was observed in the present study that MD was maldistributed nearer to the proximal site in duodenal ulcers than in gastric ulcers and the control, which was not consistent with the findings of the group Danish researchers, one of the causes of the difference may be attributed to the following : the present results were obtained by the analyses of morphological abnormalities centering on X-ray pictures, whereas their researches started and evolved from XND, so that a marked difference was produced in terms of the existence or non-existence of the clinical symptom of dyspepsia.

Henceforth, re-examination of observed cases in consideration of clinical symptoms, and the extension of items for observation are required for further comparison and examination.

CONCLUSION

The gastric ulcer group and duodenal ulcer group were compared with the control group, and each group was subdivided into a group of the malrotation of the duodenum (MD group) and a normal duodenal loop group (normal group). Each ulcer group was further classified into open stage and scar stage.

Analyses of the X-ray pictures of antroduodenal motility, including antral peristalsis (AP), longitudinal folds of the duodenum (Lf) and antral spasm (AS), were made, and the following results were obtained :

1) MD was observed in higher frequency in ulcer groups than in the control group, being significantly higher in the duodenal ulcer group, and especially at the open stage.
2) MD was detected more at the pars descendens both in the control and with gastric ulcers, whereas with duodenal ulcers, it was detected far more frequently at the pars superior.
3) In the MD group in comparison with the normal group, a tendency of the extension of the maximum diameter of the duodenum was noted.
4) In the gastric ulcer group, the rate of observing neither AP, Lf nor AS, and the rate of observing only AS, were higher than in the duodenal ulcer group, and in the latter group, the rate of observing AP, Lf, and both AP and Lf, was higher than in the former group. These higher rate for various items in the duodenal ulcer group were markedly higher in the MD group than in the normal group.
5) In the gastric ulcer group, the incidence of AS was remarkably higher than that of AP, while in the duodenal ulcer group, the finding was the reverse.

   In the gastric ulcer group, there was no significant difference of the existence and non-existence of MD, while in the duodenal ulcer group, a significant difference of AP was noted in the MD group, and of AS, in the normal group.
6) In the gastric ulcer group, AS was noted in higher incidence at the open stage than at the scar stage, irrespective of the existence or non-existence of MD, while in the duodenal ulcer group, it was detected in significantly higher incidence in the normal group, especially at the scar stage or opposed to the open stage.

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