

Hemorrhagic gastric and duodenal ulcers after the Great East Japan Earthquake Disaster

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Abstract

AIM: To elucidate the characteristics of hemorrhagic gastric/duodenal ulcers in a post-earthquake period within one medical district.

METHODS: Hemorrhagic gastric/duodenal ulcers in the Iwate Prefectural Kamaishi Hospital during the 6-mo period after the Great East Japan Earthquake Disaster were reviewed retrospectively. The subjects were 27 patients who visited our hospital with a chief complaint of hematemesis or hemorrhagic stool and were diagnosed as having hemorrhagic gastric/duodenal ulcers by upper gastrointestinal endoscopy during a 6-mo period starting on March 11, 2011. This period was divided into two phases: the acute stress phase, comprising the first month after the earthquake disaster, and the chronic stress phase, from the second through the sixth month.

The following items were analyzed according to these phases: age, sex, sites and number of ulcers, peptic ulcer history, status of *Helicobacter pylori* (*H. pylori*) infection, intake of non-steroidal anti-inflammatory drugs, and degree of impact of the earthquake disaster.

RESULTS: In the acute stress phase from 10 d to 1 mo after the disaster, the number of patients increased rapidly, with a nearly equal male-to-female ratio, and the rate of multiple ulcers was significantly higher than in the previous year (88.9% vs 25%, $P < 0.005$). In the chronic stress phase starting 1 mo after the earthquake disaster, the number of patients decreased to a level similar to that of the previous year. There were more male patients during this period, and many patients tended to have a solitary ulcer. All patients with duodenal ulcers found in the acute stress phase were negative for serum *H. pylori* antibodies, and this was significantly different from the previous year's positive rate of 75% ($P < 0.05$).

CONCLUSION: Severe stress caused by an earthquake disaster may have affected the characteristics of hemorrhagic gastric/duodenal ulcers.

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Key words: Great East Japan Earthquake Disaster; Hemorrhagic gastric; Duodenal ulcer; *Helicobacter pylori* infection; Stress

Core tip: We determined the characteristics of hemorrhagic gastric/duodenal ulcers in the post-earthquake period within one medical district. We divided hemorrhagic gastric/duodenal ulcers into two groups, the acute stress phase group, consisting of the first month after the earthquake disaster, and the chronic stress phase group, from the second through the sixth month. We concluded that severe stress caused by this

earthquake disaster exacerbated the characteristics of hemorrhagic gastric/duodenal ulcers.

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INTRODUCTION

Iwate Prefectural Kamaishi Hospital is located in the southern coastal area of Iwate Prefecture and is a regional core hospital with 15 departments and 272 beds in the Kamaishi medical district (Figure 1). This hospital is a core disaster hospital in the medical district, which has a population of approximately 55000. In the Great East Japan Earthquake Disaster that occurred on March 11, 2011, the Pacific coastal regions of East Japan suffered devastating damage from the earthquake itself and the consequent tsunami. Our hospital remained functional enough to accept all patients transported by ambulance from within the medical district, even after the disaster. The East Japan Earthquake Disaster significantly increased the occurrences of cardiovascular disease, respiratory disease, and cerebrovascular disease^[1-9]. Since the number of patients visiting our hospital with hemorrhagic gastric/duodenal ulcers increased after this disaster, we compared those patients with the analogous patient population in 2010, the pre-earthquake period. This study aimed to elucidate the characteristics of ulcers in the post-earthquake period within our medical district.

MATERIALS AND METHODS

This study included 27 patients who visited our hospital with a chief complaint of hematemesis or hemorrhagic stool and were diagnosed as having hemorrhagic gastric/duodenal ulcers by upper gastrointestinal endoscopy during a 6-mo period starting on March 11, the day of the earthquake disaster, until September 10, 2011. This period was divided into 2 phases: the acute stress phase, comprising the first month after the earthquake disaster, and the chronic stress phase, from the second through the sixth month. The following items were analyzed according to these phases: age, sex, sites and number of ulcers, peptic ulcer history, status of *Helicobacter pylori* (*H. pylori*) infection, intake of non-steroidal anti-inflammatory drugs (NSAIDs), and degrees of impact of the earthquake disaster. Moreover, these data were compared with those obtained from 27 consecutive patients who visited our hospital with a chief complaint of hematemesis or hemorrhagic stool and were diagnosed as having hemorrhagic gastric/duodenal ulcers by upper gastrointestinal

endoscopy during the same period of the previous year (March 11 to September 10, 2010). Rates of hemorrhagic gastric/duodenal ulcers reportedly increased after the earthquake disaster^[10]. We performed endoscopy only on patients who presented with a chief complaint of hematemesis or hemorrhagic stool during the first few months after the earthquake disaster, so only patients with confirmed hemorrhagic gastric/duodenal ulcers were included in this study. The status of *H. pylori* infection was determined by serum antibody titer. If the antibody titer was more than 10 U/mL, the patient was considered *H. pylori* positive. The titers of two patients were not examined because they were immediately transferred to other hospitals.

RESULTS

Hemorrhagic gastric ulcer

No patients with hemorrhagic gastric ulcers visited our hospital during the first 10 d after the earthquake disaster (Table 1, Figure 2A).

Acute stress phase (the first month after the earthquake disaster): There were 9 patients with ulcers. Compared to the mean number of patients in the previous year (3.3 patients/mo in 2010), this number represented a marked increase of approximately 3-fold after the earthquake disaster, but the difference was not statistically significant (Table 2). The mean patient age was 68.3 years, similar to that of the previous year (69.2 years). The male-to-female ratio was 6:3. Although it was not significantly different from that of the previous year (15:5), the percentage of women was higher in the study period. Regarding ulcer morphology, multiple ulcers were observed in 8 patients (88.9%), and the incidence of this form was significantly higher than in the previous year (25%) ($P < 0.005$). The most common ulcer site was the gastric corpus, seen in 7 patients (77.8%), and the rate for this site was similar to that of the previous year (85%). Four patients had an ulcer history (44.4%), and the proportion of these patients was similar to that of the previous year (35%). Five patients were positive for serum *H. pylori* antibodies (55.6%), which was slightly lower than the previous year (64%) (not statistically significant).

Chronic stress phase (the second to the sixth month after the earthquake disaster): There were 11 patients with ulcers, with the mean number being 2.2 patients/mo, indicating a significant decrease compared to the number in the acute stress phase ($P < 0.05$). Moreover, the number in the chronic stress phase was smaller than that of the previous year (3.3 patients/mo) (not statistically significant). The mean patient age was 65.8 years, again similar to that of the previous year (69.2 years). The male-to-female ratio was 8:3, which was also similar to that of the previous year (15:5). Regarding ulcer morphology, multiple ulcers were observed in 5 patients (45.5%), which was a significantly lower rate than in the acute stress phase ($P < 0.05$). Moreover, the incidence

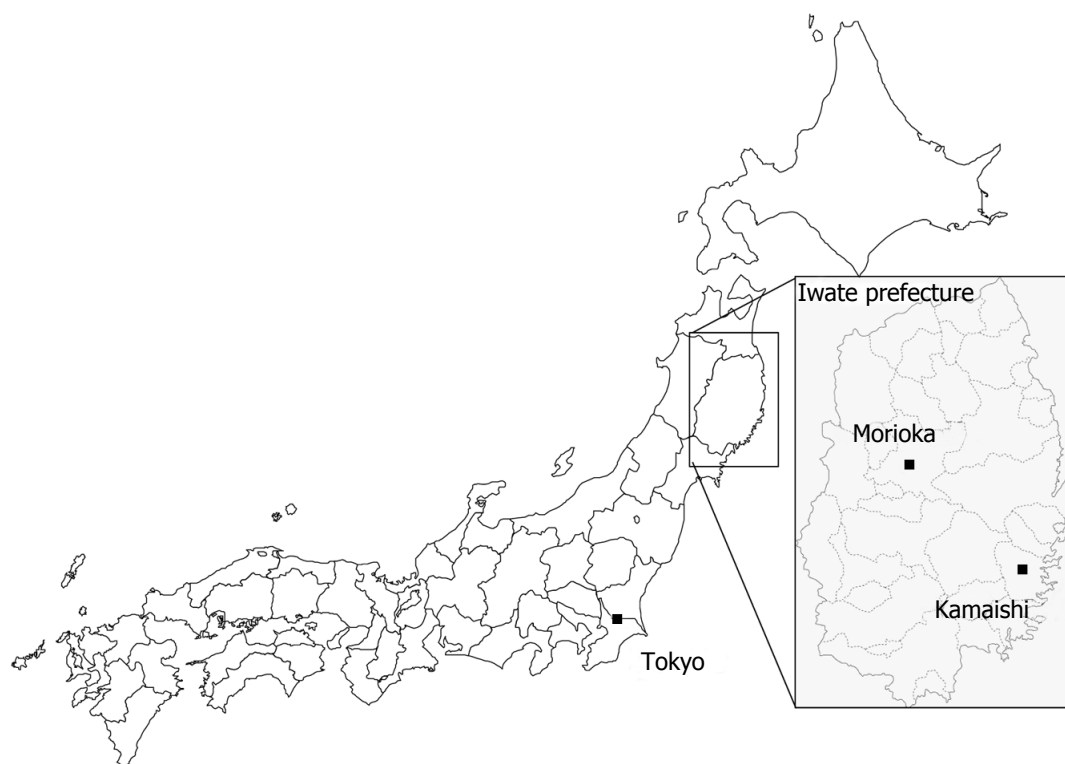


Figure 1 Location of Kamaishi city in Iwate prefecture in Japan.

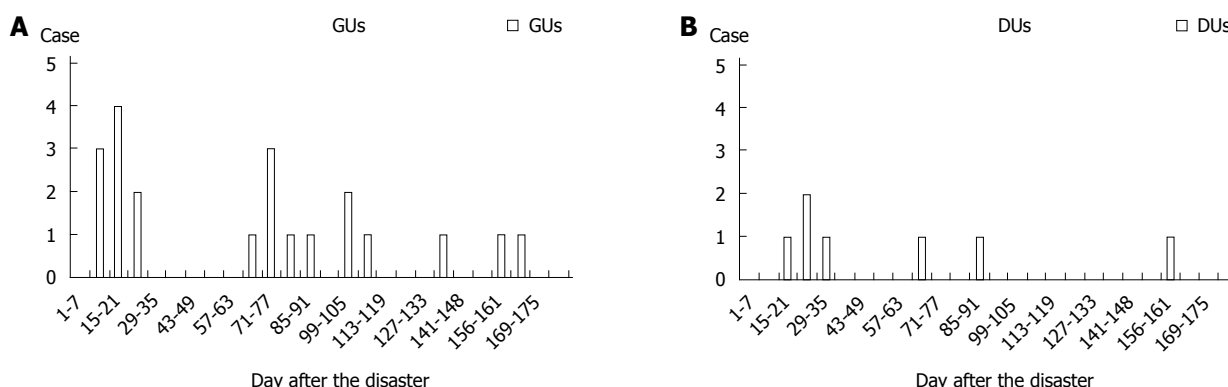


Figure 2 Incidence of hemorrhagic gastric (A) and duodenal (B) ulcers. GUs: Gastric ulcers; DUs: Duodenal ulcers.

in the chronic stress phase was nearly the same as that of the previous year (25%). Regarding ulcer site, ulcers were observed in the gastric corpus in 8 patients (72.7%), a rate that was similar to that of the previous year (85%). Three patients had an ulcer history (27.2%), and the proportion of these patients was nearly the same as that of the previous year (35%). Eight patients were positive for serum *H. pylori* antibodies (72.7%), and the proportion was similar to that of the previous year (64%).

Four of 6 patients who were negative for serum *H. pylori* antibodies used neither oral NSAIDs nor steroids at any time during the study period.

Hemorrhagic duodenal ulcer

No patients with hemorrhagic duodenal ulcers visited our hospital during the first 19 d after the earthquake

disaster (Table 3, Figure 2B).

Acute stress phase (the first month after the earthquake disaster): Three patients had ulcers. Compared to the mean number of patients in the previous year (1.2 patients/mo), this number was higher after the earthquake disaster, though it was not statistically significant (Table 2). The mean patient age was 68.6 years, similar to that of the previous year (57.3 years). The male-to-female ratio was 2:1, which was almost the same as that of the previous year (5:2). All patients showed multiple ulcers on the posterior wall. None of the patients had an ulcer history, which was lower than the previous year (75%), though not significantly. All patients were negative for serum *H. pylori* antibodies, and this was significantly different from the previous year (positive rate: 75%) ($P < 0.05$).

Table 1 Details of patients with gastric ulcers in 2011

Day	Age (yr)	Sex	Location	Number	p.h	<i>Helicobacter pylori</i> antibody titer	Property damage	Dead of family
Acute stage								
11	52	M	U	Multiple	-	+ 17.4	Complete	-
13	67	M	M	Multiple	+	- 6.6	Complete	-
13	64	F	L	Multiple	-	- < 3.0	-	Grandchild
17	80	F	M	Multiple	-	- < 3.0	-	Daughter
17	80	F	M	Multiple	+	+ unknown	Partial	-
17	61	F	M	Multiple	+	+ 31.0	-	-
21	67	M	M	Multiple	+	+ 18.6	-	-
25	62	M	M	Single	-	+ 16.3	Complete	-
27	82	M	M	Multiple	-	- 6.5	Partial	-
Chronic stage								
66	76	F	M	Multiple	+	- < 3.0	Complete	-
72	73	M	U	Multiple	-	+ 22.7	Complete	-
76	59	M	U	Single	-	+ 15.5	Complete	-
77	54	M	M	Single	-	+ 22.1	-	-
83	75	F	M	Single	-	+ 33.3	Complete	-
99	49	M	M	Single	-	- 5.2	-	-
101	67	M	M	Multiple	-	- 8.9	-	-
110	57	M	M	Multiple	+	+ 12.1	Complete	-
136	75	M	M	Single	-	+ unknown	-	-
158	82	F	U	Multiple	+	+ 27.4	-	-
164	54	M	M	Single	-	+ 25.3	Complete	Daughter

p.h.: Past history of peptic ulcer; U: Upper lesion; M: Middle lesion; L: Lower lesion.

Table 2 Characteristics of patients with gastric ulcers and duodenal ulcers

	2011 acute stage	2011 chronic stage	2010	P value
GUs				
Number of patients (n)	9	11	20	NS
Average number of patient per month	9	2.2	3.3	< 0.05 ^a
Age (yr)	68.3	65.5	69.2	NS
Male/female ratio	1.3 (5/4)	2.7 (8/3)	3 (15/5)	NS
Simple/multiple ratio	0.13 (1/8)	1.2 (6/5)	3 (15/5)	< 0.05 ^a < 0.005 ^d
<i>Helicobacter pylori</i> (+)/(-)	6/3	8/3	7/4 (unknown 9)	NS
DUs				
Number of patients (n)	3	4	7	NS
Average number of patients per month	3	0.8	1.2	NS
Age (yr)	68.6	56.3	57.3	NS
Male/female ratio	2 (2/1)	3 (3/1)	2.5 (5/2)	NS
Simple/multiple ratio	0.5 (1/2)	3 (3/1)	1.3 (4/3)	NS
<i>Helicobacter pylori</i> (+)/(-)	0/3	1/3	4/2 (unknown 1)	< 0.05 ^a

GUs: Gastric ulcers; DUs: Duodenal ulcers. ^a*P* < 0.05 between 2011 acute stage vs 2011 chronic stage; ^c*P* < 0.05, ^d*P* < 0.01 between 2011 acute stage vs 2010.

Chronic stress phase (the second to the sixth month after the earthquake disaster): Four patients had ulcers, and the mean number of 0.8 patient/mo was similar to that of the previous year (1.2 patients/mo). The mean patient age was 56.3 years, again similar to that of the previous year (57.3 years). The male-to-female ratio was 3:1, which was also quite similar to that of the previous year (5:2). Although 4 patients (100%) had an ulcer history, there was no significant difference from the previous year (43%). Three patients were positive for serum *H. pylori* antibodies (75%), and this proportion was similar to that of the previous year (67%).

DISCUSSION

Both *H. pylori* infection and NSAIDs have major roles

in the pathogenesis of peptic ulcers^[11-16]. Stress is also considered an important causal factor in peptic ulcer disease^[17], and there are studies on the involvement of *H. pylori* infection and stress in the incidence of peptic ulcers after the Great Hanshin-Awaji Earthquake Disaster in 1995^[18-20].

In the Great East Japan Earthquake Disaster that occurred on March 11, 2011, the Kamaishi medical district (population of approximately 55000), where our hospital is located, also suffered serious damage due to the tsunami, and the combined number of dead and missing persons was approximately 2300. Many disaster victims also lost their homes. They were forced to stay at shelters or to live without adequate infrastructure, such as gas, water, and electricity supplies. These disaster victims experienced severe and unprecedented stress,

Table 3 Details of patients with duodenal ulcers in 2011

Day	Age (yr)	Sex	Location	Number	p.h.	<i>Helicobacter pylori</i> antibody titer	Property damage	Dead family
Acute stage								
19	85	M	AW/PW	Multiple	-	< 3.0	Complete	Wife
23	51	M	PW	Single	-	< 3.0	Complete	-
25	70	F	PW	Multiple	-	< 3.0	Complete	Son
Chronic stage								
35	59	M	PW	Single	+	3.4	Complete	-
65	72	F	AW/PW	Multiple	+	10.3	-	-
87	59	M	PW	Single	+	15.5	-	-
159	35	M	AW	Single	+	34.3	-	-

p.h.: Past history of peptic ulcer; AW: Anterior wall; PW: Posterior wall.

which persisted for a considerable period of time. In this study, the acute stress phase was defined as the first month, when numerous aftershocks occurred and when the disaster victims lived under extremely severe stress due to poor living conditions. The chronic stress phase was defined as the period from the second through sixth month after the earthquake disaster. We analyzed the clinical and demographic data of ulcer patients for each period.

Because the emergency transport routes were restored the day after the earthquake, many patients were transported to our hospital immediately after this disaster. Nevertheless, the day when the first patient visited our hospital with a chief complaint of hematemesis or hemorrhagic stool after the earthquake was March 22, 11 d after the disaster. Subsequently, the number of patients visiting our hospital with one of these chief complaints gradually increased, and 12 patients (mean: 3 patients/wk) with hemorrhagic gastric/duodenal ulcer visited in the first month. Because the mean number of patients with hemorrhagic gastric/duodenal ulcers for a period of 6 mo starting March 11, 2010, had been 1.13 patients/wk, there was an apparent increase after the March 11, 2011 earthquake disaster. However, the number rapidly decreased after the first month, and the subsequent mean number was 0.75 patient/wk, which was slightly lower than that of the previous year.

Matsuura *et al*^[21] studied upper gastrointestinal bleeding after the Great East Japan Earthquake Disaster and found that there were few patients immediately after the earthquake disaster but that the number increased from a few days to 1 mo after the disaster. According to a study conducted in 1998 on peptic ulcers occurring after the Great Hanshin-Awaji Earthquake Disaster^[18], Aoyama *et al*^[18] also reported that the number of patients decreased during the first 2 wk after the earthquake disaster as compared to the previous year, then increased during the third through fourth weeks, and returned to a similar level to that of the previous year from the fifth through sixth weeks. Takakura *et al*^[22] also reported that the number of patients with gastric ulcers increased by 4-fold 2 wk after the Great Hanshin-Awaji Earthquake Disaster, gradually decreased thereafter, and it had returned to near the level of the previous year 2.5 mo later. Our data show a

similar trend to these reports. The increase in the number of patients during the acute stress phase strongly suggests that severe stress due to the violent earthquake and consequent tsunami contributed to the ulcer incidence. We have no clear explanation why the incidence of hemorrhagic gastric/duodenal ulcers was low during the first 10 d after the earthquake disaster, a time when the disaster victims were under extremely severe stresses concerning matters of life and death. It was assumed that stressful conditions might need to persist for a certain period of time before the breakdown of biological defense mechanisms.

The male-to-female ratio of gastric ulcer patients was 6:3. However, the ratio in the chronic stress phase was 8:3, a higher percentage of men. The examination of the data obtained during the same period in 2010 at our hospital also shows that the male-to-female ratio was 15:5, indicating a trend for a much higher percentage of men. Moreover, a study conducted in Japan found that the male-to-female ratio among peptic ulcer patients was 71:29, indicating that this disease occurs approximately 2.4 times more frequently in men than in women^[23]. Based on a comparison of these data, an approximately equal incidence between men and women might be one of the characteristics of gastric ulcer presumably caused by acute stress after an earthquake disaster. Meanwhile, the male-to-female ratios for duodenal ulcer were 2:1 in the acute stress phase and 3:1 even in the chronic stress phase. These ratios were essentially consistent with the trends observed in most studies, and we assume that there are gender differences in the incidence of gastric and duodenal ulcers caused by acute stress.

The mean age of patients with gastric ulcers was 68.3 or 65.5 years old in the acute stress phase or chronic stress phase, respectively, which were not significantly different. The mean ages of those with duodenal ulcers were 68.6 and 56.3 years, respectively, indicating that the patients tended to be older in the acute stress phase.

Regarding the number of gastric ulcer lesions, multiple ulcers were observed in 8 (88.9%) of 9 patients in the acute stress phase. On the other hand, multiple ulcers were observed in 5 (45.5%) of 11 patients in the chronic stress phase, and an increase in the number of patients with a solitary ulcer was documented. Regarding

the number of duodenal ulcer lesions, multiple ulcers were observed in 2 (66.7%) of 3 patients in the acute stress phase. In the chronic stress phase, only 1 (25%) of 4 patients had multiple ulcers. According to the data on patients at our hospital during the same period in 2010, 5 (25%) of 20 patients had multiple gastric ulcers, and 3 (42.9%) of 7 patients had multiple duodenal ulcers. Thus, both hemorrhagic gastric and duodenal ulcers in the acute stress phase were often multiple. Kanno *et al.*^[24] reported that post-disaster hemorrhagic ulcers were frequently observed in the stomach as multiple ulcers at the same time.

Five (55.6%) of 9 patients in the acute stress phase and 8 (72.7%) of 11 patients in the chronic stress phase were positive for *H. pylori* antibodies. All patients of hemorrhagic gastric/duodenal ulcers had no history of eradication therapy of *H. pylori*. During the same period in 2010 (excluding unknown cases), 7 (63.6%) of 11 patients were *H. pylori* positive, a number similar to that after the earthquake disaster. In contrast, none of the 3 patients with duodenal ulcers was positive for *H. pylori* antibodies in the acute stress phase, and this incidence was significantly lower than that of the chronic stress phase, in which 4 (100%) of 4 patients were positive. During the same period in 2010, 4 (66.7%) of 6 patients with duodenal ulcers were positive for *H. pylori* antibodies. The rate of peptic ulcer not associated with the use of drugs, such as NSAIDs, in Japanese patients negative for *H. pylori* infection was reported by Aoyama *et al.*^[25] to be 1.9% to 5.1% and by Nishikawa *et al.*^[26] to be 1.3%. However, Kanno *et al.*^[10] reported that patients with non-*H. pylori* and non-NSAID gastroduodenal ulcers accounted for as many as 24% of cases after the Great East Japan Earthquake Disaster, and their analysis showed that there were many cases with ulceration attributable to stress. In this study, 8 (29.6%) of 27 patients, including those with gastric/duodenal ulcers, were negative for *H. pylori* antibodies and had not taken oral NSAIDs. The incidence of such cases was extremely high. All 8 patients were experiencing overwhelming stress. For example, they had dead or missing family members or were forced to stay at shelters due to the complete destruction of their homes. This raises the possibility that hemorrhagic gastric/duodenal ulcers can be caused by stress alone.

We did not encounter patients with hemorrhagic acute gastric mucosal lesion that might have been induced by primary infection by *H. pylori*. There is a minor possibility that those patients got acutely infected by *H. pylori* and were not yet serologically positive. However, no incident of waterborne infection was reported in this area during the period, and the quality of most sources of drinking water was maintained in a hygienic state. We do not think that a majority of them got infected by *H. pylori* during the study period.

As to the location of hemorrhagic duodenal ulcers, all patients had ulcers in the posterior wall of the bulb in the acute stress phase. The proportion of these patients was higher than in the chronic stress phase and the previous year. Although the difference between

these proportions was not statistically significant, stress-induced duodenal ulcers without *H. pylori* infection may tend to occur in the posterior wall of the bulb.

Our study has some limitations. This was an observational analysis that was performed on a limited closed lesion with a small sample size. Under the confused and extraordinary circumstances in the aftermath of the great disaster, detailed examinations were difficult to perform. Endoscopic examinations were mainly performed for hemorrhagic gastric/duodenal ulcers. Therefore, the pathophysiology and incidence of non-hemorrhagic and asymptomatic peptic ulcers are unknown. However, we expect that this study has some useful information for the care of hemorrhagic gastro/duodenal injury at times of great disasters.

In conclusion, severe stress caused by an earthquake disaster may have affected the characteristics of hemorrhagic gastric/duodenal ulcers.

COMMENTS

Background

Under severe stress, the incidence of hemorrhagic gastric/duodenal ulcers increases. However, there are few reports on the incidence and characteristics of hemorrhagic gastric/duodenal ulcers after a great earthquake disaster. Since the number of patients visiting our hospital with hemorrhagic gastric/duodenal ulcers increased after the Great East Japan Earthquake Disaster, the authors compared those patients with hemorrhagic gastric/duodenal ulcer patients in 2010, the pre-earthquake period. This study aimed to elucidate the characteristics of ulcers in the post-earthquake period within one medical district.

Research frontiers

It is not well known whether severe stress independently causes hemorrhagic gastric/duodenal ulcers without *Helicobacter pylori* (*H. pylori*) infection and non-steroidal anti-inflammatory drug (NSAID) use.

Innovations and breakthrough

In this medical district, all patients who developed gastric/duodenal ulcers were admitted to one hospital. Therefore, interesting differences in the characteristics of hemorrhagic ulcers before and after the earthquake disaster were observed. Moreover, it is presumed that severe stress caused by this earthquake disaster may have affected the characteristics of hemorrhagic gastric/duodenal ulcers without *H. pylori* infection and NSAIDs.

Applications

This study will provide some useful information for the care of hemorrhagic gastro/duodenal injuries at the time of a great disaster.

Terminology

The Great East Japan Earthquake Disaster occurred on March 11, 2011. The Pacific coastal regions of East Japan suffered devastating damage by the earthquake itself and the consequent tsunami.

Peer review

This is an important study in which dynamic changes in the characteristics of complicated peptic ulcer patients is depicted. Taking care of patients and performing such an analysis in a devastating circumstance is encouraging to all.

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