What is the concept of “Dumping syndrome” after upper gastrointestinal surgery?

– A proposal of questionnaire to evaluate dumping symptoms from surgeon’s perspectives.

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Abstract

Background: The term “Dumping syndrome (DS)” is well-known among surgeons, however, its definition and diagnostic rule are still unclear. The aim of this study was to provide a general concept of DS and a relevant questionnaire to evaluate the symptoms from surgeon’s perspectives.

Methods: According to the established psychometrics methods of the scale development, we conducted this study; consensus meeting, item pool, qualitative survey, making draft scale, item selection and internal validation. In the validation, 359 patients who underwent surgery for gastric or esophageal cancer were enrolled. To assess the conceptual validity of DS, the exploratory factor analysis was conducted, and the subscale design and items were determined.

Results: A total of 359 patients were enrolled, and answers were obtained from 344 patients (95.8%), included 225 gastric cancer patients, 107 esophageal cancer patients and 12 other malignant disease in stomach patients. The symptoms of sleepiness, upper abdominal discomfort, gurgling noise and diarrhea after eating were common symptoms in patients. The timing of symptoms occurring were a normal distribution. After the factor analyses, 10 items and 2 domains were isolated: systemic symptoms and abdominal symptoms.

Conclusion: We have suggested a concept of DS after upper gastrointestinal surgery and provided an assessment scale.

Keywords: dumping syndrome, gastrectomy, esophagectomy, assessment scale, questionnaire

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Introduction

The most important function of the stomach is the pooling of food. This function can be lost permanently in patients who undergo gastrectomy or esophagectomy, and as a result, food immediately advances to the reconstructed small intestine, which causes troublesome symptoms in these patients. These symptoms can be specific as well as systemic and include fatigue, face flushing, dizziness, palpitation and cold sweat¹⁾. Furthermore, while a rare occurrence, some severe patients develop syncope and are brought to an emergency department. Surgeons conventionally called these symptoms “dumping syndrome (DS)”. However, while the term DS is well known among surgeons, its definition and diagnosis are poorly understood.

DS has been described in conventional textbooks of medicine or surgery to include an early phase that occurs within 30 minutes after a meal and a late phase that occurs 2 h after a meal²⁾. In addition, from a pathophysiological perspective, the early phase has been suggested as potentially related to the effects of hormones secreted from the intestine, and the late phase might be induced by the sharp drop in the level of glucose in the blood. This theory was based on a report published more than 40 years ago suggesting a diagnostic scoring system for DS¹⁾. With this system, patients intake glucose-rich water in one gulp, and physicians evaluate whether or not they have specific symptoms of DS. This challenge test has not been widely accepted due to the large burden and risk for patients. We have therefore long had no diagnostic or assessment tool of DS. We also lack a deliberate consensus or definition of DS, even though “DS” is widely known as a medical term. Therefore, when conducting clinical research to evaluate patients’ sequelae after gastrectomy, it is difficult to set measurable and validated outcomes.

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We previously developed a reliable and validated questionnaire to assess the symptoms in patients who have undergone gastrectomy or esophagectomy^{3, 4)}. We identified diet-induced systemic symptoms (DISs) in patients with a history of gastrectomy that were clearly distinguished from other abdominal or thoracic symptoms from the perspective of psychometrics. These findings suggest that these DISs might be the same kind of clinical sequelae as DS. The aim of the present study was to establish a general concept of DS and a clinically relevant questionnaire to evaluate the symptoms. Our proposal would be expected to provide useful information for surgeons who are planning the clinical study to assess post-gastrectomy sequela.

Patients and methods

The study was a cross-sectional survey carried out at four participating institutes from November 2011 to January 2013. The fixed dataset was obtained from the ES⁴ study³⁾, and this study protocol was approved by the institutional review board of all hospitals.

Enrolled patients

Patients were considered to be eligible if they had undergone surgery for gastric or esophageal cancer. All patients were at least 20 years of age, and the time after operation ranged from 6 months to 5 years. Patients were required to have an Eastern Cooperative Oncology Group performance status of 0 or 1. The exclusion criteria included the following: patients currently undergoing or having undergone within the past three months chemotherapy or radiotherapy; patients with recurrence or other malignant disease; patients who were pregnant and patients currently taking antipsychotics, antidepressants or antianxiety medication. All of the patients provided their signed informed consent.

Survey items

We described the item pooling and selection methods in the draft scale of our previous report³⁾. In brief, we held a consensus meeting to pool items and performed a semi-structured interview of 12 patients and preliminary test in 22 patients. Finally, we selected 14 items (Table 2) as the draft scale and investigated the time from eating to symptoms occurring.

Psychometric assessment and subscale design

To assess the conceptual validity of DS, we evaluated the descriptive statistics of each item. In addition, an exploratory factor analysis (principal factor method with Promax rotation) was conducted to determine the subscale design and items.

Results

Table 1 shows the patients' characteristics. A total of 359 patients were enrolled, and answers were obtained from 344 patients (95.8%), including 225 gastric cancer patients, 107 esophageal cancer patients and 12 other malignant disease in stomach patients. All patients received radical resection, and 162 (47.1%) underwent a laparoscopic approach. Table 2 shows the descriptive statistics of the answers. Sleepiness, upper abdominal discomfort, gurgling noise and diarrhea after eating were common symptoms in patients. Figure 1 shows the time interval between eating and symptoms occurring followed a normal distribution.

Subscale design of DS

In the exploratory factor analysis (principal factor method) of 14 items, the scree plot (Figure 2) and eigenvalue attenuation showed a structure of two factors. Items that had a large factor loading value for both factors were deleted. The factor loading value and plot for each domain are shown in Table 3 and Figure 3. As a result, 10 items and 2 domains were isolated: systemic symptoms and abdominal symptoms. The correlation between the 2 factors was 0.372.

Discussion

In the present study, we tried to establish the concept of DS after upper gastrointestinal surgery. The term "dumping" was initially derived from food directly dropping into the small intestine, like a "dump truck". The concept of DS is expected to consist of symptoms induced by the daily diet in patients who have undergone gastrectomy or esophagectomy⁵⁾. We supposed that DS included two clear domains: systemic and abdominal symptom after eating. The systemic symptoms have long been reported to occur in early or late phases in a lot of conventional textbooks or articles^{2, 6-9)}, however, the time interval between eating and symptoms occurring shows a normal distribution of around 30 to 120 minutes in our results.

Several previous reports have tried to evaluate DS. Mine et al. conducted a large-scale survey of 1,153 gastrectomy patients to investigate DS using a visual analog scale¹⁰⁾. However, the results had too strong floor effects in all items to compare the risk of incident of DS among some operative procedures. The visual analog scale and the form of the questionnaire might have been inappropriate for identifying patients with DS. Nakamura et al. developed an assessment scale known as "Dysfunction After Upper Gastrointestinal Surgery (DAUGS)"^{11, 12)}. Although they described one factor of this scale as

Table 1 Patients' characteristics

N =344		
Male / Female	231/113	
Median age (range, SD)	66	(32 - 85, 9.82)
Body mass index (range, SD)	19.7 kg/m ²	(12.7 - 34.4, 2.72)
Postoperative period (range, SD)	2.71 year	(0.5 - 5, 2.54)
Disease		
Gastric cancer (Stage I / II / III)*	225 (141/ 52 / 32)	65.4%
Esophageal cancer (Stage I / II / III)*	107 (32 / 41 / 42)	31.1%
Other malignant diseases in stomach	12	3.5%
Operative procedure		
Esophagectomy	111	32.3%
Total gastrectomy	92	26.7%
Distal gastrectomy	99	28.7%
Proximal gastrectomy	15	4.4%
Pylorus preserving gastrectomy	24	7.0%
Local resection of stomach	3	0.8%

SD; standard deviation

(*) Stage conformed to the International Union Against Cancer (UICC), TNM Classification 7th edition

Table 2 Items of questionnaire and distribution of occurrence and severity

Items	Total N=344		Severity of the symptom				Data missing
	symptom positive	(%)	minimal	mild	moderate	severe	
1 Have you feel your heart throbbing after eating?	107	(31.1)	17	59	25	6	31
2 Have you felt dizziness after eating?	64	(18.6)	15	40	9	2	35
3 Have you felt numbness in your hand or legs after eating?	34	(9.9)	8	20	6	1	36
4 Have you felt listless or fatigued after eating?	135	(39.2)	26	72	33	6	30
5 Have you felt extreme sleepiness after eating?	185	(53.8)	37	79	56	13	26
6 Have you felt flush in your face after eating?	39	(11.3)	11	22	9	0	34
7 Have you felt weak in the body after eating?	80	(23.3)	20	40	21	3	33
8 Have you felt hunger suddenly after eating?	60	(17.4)	21	32	8	1	38
9 Have you fainted, or felt like you were going to faint, after eating?	17	(4.9)	4	9	5	1	39
10 Have you heard gurgling noises from your abdomen after eating?	166	(48.3)	45	81	39	5	34
11 Have you had abdominal pain immediately after eating?	130	(37.8)	30	53	40	7	37
12 Did you have diarrhea immediately after eating?	160	(46.5)	27	77	46	14	29
13 Have you had nausea or vomit immediately after eating?	88	(25.6)	19	51	15	6	37
14 Have you had discomfort of abdomen immediately after eating?	175	(50.9)	44	90	40	4	36

Figure 1 Timing of symptoms occurring

The histogram shows the proportion of time interval between eating and symptoms occurring (multiple answer allowed).

Table 3 Factor analysis and scale design

		Factor 1	Factor 2
1 Systemic symptoms	Have you feel your heart throbbing after eating?	0.307	0.054
	Have you felt dizziness after eating?	0.421	-0.078
	Have you felt listless or fatigued after eating?	0.448	0.087
	Have you felt extreme sleepiness after eating?	0.354	-0.021
	Have you felt weak in the body after eating?	0.446	0.060
	Have you fainted, or felt like you were going to faint, after eating?	0.443	-0.094
2 Abdominal symptoms	Have you heard gurgling noises from your abdomen after eating?	-0.037	0.495
	Have you had abdominal pain immediately after eating?	0.024	0.460
	Did you have diarrhea immediately after eating?	-0.035	0.534
	Have you had discomfort of abdomen immediately after eating?	0.070	0.478

Eigenvalues

Figure 2 Scree plot of eigenvalues.
Two points are evident in the eigenvalue > 1.

Figure 3 Component loadings
Factor loadings plot in the two dimension by principal factor method with Promax rotation in each question.

‘dumping-like symptoms’, the concept and definition of ‘dumping-like’ remained unclear. In addition, the dumping syndrome rating scale (DSRS) was also published¹³⁾, targeting patients who had received bariatric surgery. That scale also evaluated the psychometrical validity and reliability. It consisted of 23 items focused on disorder within 30 minutes after eating. In the present study, we found that DISs occurred up to two hours after a meal in most patients.

A major problem with regard to DS is that we have no clear concept or pathophysiologic theories. Until a concept of DS is clearly established, we cannot evaluate the severity of DS among patients who have received gastrectomy.

The limitation of this present study is the absence of an assessment of the external validity; the correlation of other clinical indicators or comprehensive quality of life scales may need to be evaluated. In a future study, we plan on evaluating the relationship between patients with dumping symptoms and the nutrition status or quality of life summary scores as a validation study.

Conclusion

We proposed a concept of DS that was composed of two components; systemic and abdominal symptoms induced by diet. In addition, to discriminate DS from other sequelae, we established a clinically useful questionnaire including 10 items.

Reference

- 1) Sigstad H. A clinical diagnostic index in the diagnosis of the dumping syndrome. Changes in plasma volume and blood sugar after a test meal. *Acta Med Scand* 1970, 188(6): 479-486.
- 2) Johnson LP, Sloop RD, Jesseph JE. Etiologic significance of the early symptomatic phase in the dumping syndrome. *Annals of surgery* 1962, 156: 173-179.
- 3) Honda M, Wakita T, Onishi Y, Nunobe S, Hiki N, Miura A, Nishigori T, Kusanagi H, Yamamoto T, Kobayashi K et al. Development and validation of a symptom scale to evaluate post-operative patients with esophagogastric cancer. *Journal of the American College of Surgeons* 2014, 219(5): 895-903.
- 4) Honda M, Wakita T, Onishi Y, Nunobe S, Miura A, Nishigori T, Kusanagi H, Yamamoto T, Boddy A, Fukuhara S. Development and Validation of a Disease-Specific Instrument to Measure Diet-Targeted Quality of Life for Postoperative Patients with Esophagogastric Cancer. *Annals of surgical oncology* 2015.
- 5) Lawaetz O, Aritas Y, Blackburn AM, Ralphs DN. Gastric emptying after peptic ulcer surgery. Some pathophysiological mechanisms of the dumping syndrome. *Scandinavian journal of gastroenterology* 1982, 17(8): 065-1072.
- 6) Adachi Y, Suematsu T, Shiraishi N, Katsuta T, Morimoto A, Kitano S, Akazawa K. Quality of life after laparoscopy-assisted Billroth I gastrectomy. *Annals of surgery* 1999, 229(1): 49-54.
- 7) Nunobe S, Okaro A, Sasako M, Saka M, Fukagawa T, Katai H, Sano T. Billroth I versus Roux-en-Y reconstructions: a quality-of-life survey at 5 years. *International journal of clinical oncology* 2007, 12(6): 433-439.
- 8) Nunobe S, Sasako M, Saka M, Fukagawa T, Katai H, Sano T. Symptom evaluation of long-term postoperative outcomes after pylorus-preserving gastrectomy for early gastric cancer. *Gastric cancer : official journal of the International Gastric Cancer Association and the Japanese Gastric Cancer Association* 2007, 10(3): 167-172.
- 9) Ukleja A. Dumping syndrome: pathophysiology and treatment. *Nutr Clin Pract* 2005, 20(5): 517-525.
- 10) Mine S, Sano T, Tsutsumi K, Murakami Y, Ehara K, Saka M, Hara K, Fukagawa T, Udagawa H, Katai H. Large-scale investigation into dumping syndrome after gastrectomy for gastric cancer. *Journal of the American College of Surgeons* 2010, 211(5): 628-636.
- 11) Nakamura M, Hosoya Y, Umeshita K, Yano M, Doki Y, Miyashiro I, Dannoue H, Mori M, Kishi K, Lefor AT. Postoperative Quality of Life: Development and Validation of the “Dysfunction after Upper Gastrointestinal Surgery” Scoring System. *Journal of the American College of Surgeons* 2011, 213(4): 508-514.
- 12) Nakamura M, Kido Y, Egawa T. Development of a 32-item scale to assess postoperative dysfunction after upper gastrointestinal cancer resection. *Journal of Clinical Nursing* 2008, 17(11): 1440-1449.
- 13) Laurenus A, Olbers T, Naslund I, Karlsson J. Dumping syndrome following gastric bypass: validation of the dumping symptom rating scale. *Obesity surgery* 2013, 23(6): 740-755.