J Tokyo Wom Med Univ
84 (Extra 3) E389～E396 (2014)

Original

Changes in Body Composition after Gastrectomy: Comparison between Distal Gastrectomy and Total Gastrectomy

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(Accepted October 14, 2014)

"Sarcopenia" refers to a loss of muscle mass with aging, and can occur with decreased nutritional status after gastrectomy. This study measured body composition in 145 patients using bioelectrical impedance analysis (BIA) after distal gastrectomy (DGR group, n = 108) or total gastrectomy (TGR group, n = 37) for gastric cancer. Evaluated parameters included pre- and postoperative body weight, fat mass, and body cell mass (BCM), which reflects nutritional status and correlates with skeletal muscle. In addition, patients with postoperative follow-up < 24 months were defined as "early-term", while those with follow-up ≥ 24 months were "latter-term". Body weight decreased after gastrectomy, decreasing more after TGR than after DGR. BCM was also lower in both DGR and TGR groups than in healthy controls, but tended to be even lower in the TGR group. In the TGR group, BCM tended to be lower in the latter-term group, and patients with low BCM were also significantly more frequent. In addition, fat mass was lower than in healthy controls, but remained significantly higher in the latter-term group. In the DGR group, BCM and fat mass did not differ significantly between early- and latter-term groups. These results suggest that sarcopenia may more readily progress long-term after TGR than after DGR.

Key Words: bioelectrical impedance analysis (BIA), nutritional status, gastrectomy, BCM, sarcopenia

Introduction

Sarcopenia has become a common term in referring to the loss of muscle mass that occurs with aging. The European Working Group on Sarcopenia in Older People (EWGSOP)[1] in 2010 classified sarcopenia into primary sarcopenia, associated with aging, and secondary sarcopenia, due to causes such as malignant tumors, organ dysfunction, and malnutrition. Decreased nutritional status after gastrectomy is a well-known problem, but measurement of body composition as a method of assessment has not been fully investigated. Bioelectrical impedance analysis (BIA) measures electrical resistance in the body and offers a convenient and noninvasive method for evaluating body composition. Research with BIA started during the 1960s[2][3], and now with the development of multifrequency and multipolar tactile-electrode impedance methods, measurement accuracy has improved dramatically[4]~[6]. The present study measured the body cell mass (BCM) and fat mass of postgastrectomy patients using the BIA method and investigated differences in body composition characteristics after distal gastrectomy (DGR) and total gastrectomy (TGR).

Materials and Methods

A retrospective investigation of 145 patients who had undergone gastrectomy for gastric cancer at our department and who underwent body composition analysis between September 2012 and January 2013 during postoperative follow-up was conducted. Patients were divided into a distal gastrectomy group (DGR group, n = 108) and a total gastrectomy group (TGR group, n = 37), and the groups were compared. Body composition analysis was performed using an InBody 720 system (Biospace, Tokyo, Japan). This body composition analyzer features multifrequency analysis, body segment measurement, and eight-point tactile electrodes, and it

Table 1 BCM and fat mass in healthy controls (Data provided by Biospace Co.)

Women	20s (n = 327)	30s (n = 201)	40s (n = 200)	50s (n = 151)	60s (n = 273)	70s + (n = 191)
Fat mass (kg)	14.8 ± 4.86	16.0 ± 5.34	18.1 ± 5.18	20.3 ± 5.36	21.2 ± 5.91	19.3 ± 6.41
BCM (kg)	25.8 ± 2.45	25.5 ± 2.64	25.5 ± 2.49	24.8 ± 2.85	23.5 ± 2.58	22.2 ± 2.36

Men	20s (n = 441)	30s (n = 343)	40s (n = 288)	50s (n = 164)	60s (n = 116)	70s + (n = 71)
Fat mass (kg)	11.9 ± 6.10	15.0 ± 5.79	16.3 ± 5.07	16.2 ± 4.44	16.7 ± 5.46	15.8 ± 5.12
BCM (kg)	37.8 ± 5.07	37.1 ± 4.38	36.5 ± 4.21	34.4 ± 4.14	33.1 ± 4.15	29.5 ± 3.77

Body composition by sex and age in healthy East Asian controls as measured by bioelectrical impedance analysis using an InBody720 body composition analyzer. Data are presented as mean ± standard deviation.

delivers highly accurate and reproducible body composition measurements[7)8)]. The InBody720 uses BIA to obtain quantitative data for five components: intracellular water, extracellular water, protein, fat, and mineral content. The BCM is calculated based on body weight minus extracellular components, in other words, as protein plus intracellular water content. The present study investigated body weight before and after surgery, as well as fat mass and BCM measurements obtained from body composition analysis. BCM is a concept proposed by Moore et al. involving regulation of body metabolism, and it reflects the nutritional status of the body[9)]. Since body composition is affected by age and sex, statistical analyses in the present study were based on BCM and fat mass values for each patient calculated as proportions of the mean values for healthy controls (Table 1) by age and sex. Patients with a ≥5% reduction in the BCM from that in healthy controls were defined as having a "low BCM" and were added to the analysis. In addition, patients with postoperative follow-up < 24 months were defined as the "short-term group," while those with follow-up ≥24 months were the "long-term group"; these groups were also compared. Statistical analysis was performed using JMP Ver. 10.0.2, and the Wilcoxon signed-rank test or Chi-square test were used for comparisons between the DGR and TGR groups and between the short- and long-term groups. Comparison with healthy controls was performed using Student's *t*-test with the healthy control data in Table 1 fitted to a normal distribution. Significance was set at $p < 0.05$. The study was approved by the ethics review board of the university (Approval No. 2826-R), and verbal consent for participation was obtained from all patients. No patients declined to participate.

Results

1. Preoperative/postoperative changes in body weight

Table 2 summarizes patient characteristics. Patient age, sex, preoperative body weight, preoperative BMI, and gastric cancer stage did not differ significantly between the TGR and DGR groups. Postoperative follow-up was significantly longer in the TGR group, but after classification into short- and long-term groups, the duration of postoperative follow-up did not differ significantly between the TGR and DGR groups.

Table 3 shows postoperative changes in body weight. A comparison of pre- and postoperative body weights showed a significant decrease in body weight after surgery in both the TGR and DGR groups. The percentage reduction in body weight was significantly larger in the TGR group than in the DGR group.

2. BCM and fat mass

Table 4 shows the results of body composition analysis. The mean BCM as a proportion of the healthy control mean BCM was 0.947 ± 0.113 in the DGR group and 0.920 ± 0.114 in the TGR group. Both were significantly lower than in healthy controls. The percentage of patients with a low BCM was more than half in each group, at 52.8% in the DGR group and 62.1% in the TGR group. The proportion with a low BCM tended to be higher in the TGR group, but no significant difference was seen between surgical procedures. Fat mass was signifi-

Table 2 Characteristics of the 145 patients

	DGR group (n = 108)	TGR group (n = 37)	p-value
Age (y)	69.6 ± 11.1	68.5 ± 10.1	
Male/Female	79/29	26/11	NS
Preoperative BMI (kg/m^2)	22.5 ± 3.23	22.6 ± 3.85	
Preoperative body weight (kg)			
Total	60.0 ± 11.2 (n = 108)	59.0 ± 11.6 (n = 37)	
Early-term group	60.1 ± 10.9 (n = 35)	55.0 ± 9.6 (n = 7)	NS
Latter-term group	59.8 ± 11.6 (n = 73)	60.2 ± 12.0 (n = 30)	
Postoperative follow-up (month)			
Total	54.4 ± 56.5 (n = 108)	93.3 ± 69.2 (n = 37)	0.001
Early-term group	11.5 ± 5.69 (n = 35)	13.7 ± 8.04 (n = 7)	NS
Latter-term group	74.9 ± 58.4 (n = 73)	111 ± 63.7 (n = 30)	NS
Stage			
I	71	21	
II	17	9	
III	16	5	NS
IV	2	1	
Unknown	2	1	

Comparison of the patients' characteristics for the TGR and DGR groups shows no significant differences regarding patient age, sex, preoperative body weight, preoperative BMI, and gastric cancer stage. Postoperative follow-up is significantly longer in the TGR group, but after classifying patients into early- and latter-term groups, duration of postoperative follow-up did not differ significantly between the TGR and DGR groups.

Table 3 Comparison of body weight between the DGR and TGR groups

	Pre-operation	Post-operation	p-value
Body weight (kg)			
DGR group	59.1, 34.8-84.1 (60.0 ± 11.2)	53.9, 32.5-78.6 (55.1 ± 10.5)	<0.001
TGR group	58.2, 38.2-84.5 (59.0 ± 11.6)	50.5, 31.1-73.4 (50.7 ± 9.0)	<0.001

	DGR	TGR	p-value
Percentage reduction	93.5 ± 11.4%	85.7 ± 12.9%	<0.001

Data are expressed as median, minimum-maximum (and mean ± SD). Postoperative body weight is significantly decreased in both the TGR and DGR groups. Furthermore, the percentage reduction in body weight is significantly greater in the TGR group than in the DGR group.

cantly lower in the TGR group than in the DGR group. Fat mass, as a proportion of mean healthy control values, was 0.717 ± 0.332 in the DGR group and 0.505 ± 0.222 in the TGR group. Fat mass in the TGR group was about half that in healthy controls.

3. Comparison of short- and long-term groups

Table 5 summarizes the comparisons between the short- and long-term groups for each surgical procedure. For the DGR group, a comparison between short- and long-term groups showed no significant differences in body weight, fat mass, or BCM. However, in the TGR group, although the comparison between short- and long-term groups found no significant difference in body weight, fat mass was significantly higher in the long-term group. In addition, BCM, as a proportion of the healthy control mean, tended to be lower in the long-term group (0.909 ± 0.120) than in the short-term group (0.967 ± 0.070). The proportion of patients with low BCM was significantly higher in the long-term group (70.0%) than in the short-term group (28.6%).

Table 4 Comparison of BCM and fat mass between the DGR and TGR groups

	DGR group (n = 108)	TGR group (n = 37)	p-value
BCM			
BCM (kg)	27.5, 17.5-36.8 (27.7 ± 4.80)	26.6, 14.2-40.0 (26.9 ± 5.01)	0.3404
Proportion of the healthy control	0.942, 0.681-1.421 (0.947 ± 0.113)	0.922, 0.640-1.162 (0.920 ± 0.114)	0.3533
p-value (vs healthy control)	< 0.001	< 0.001	
Low BCM	52.8% (n = 51)	62.1% (n = 23)	0.3197
Fat mass			
Fat mass (kg)	10.6, 1.0-31.2 (12.1 ± 5.68)	8.1, 3-16.7 (8.7 ± 3.68)	< 0.001
Proportion of the healthy control	0.637, 0.047-1.617 (0.717 ± 0.332)	0.512, 0.180-0.886 (0.505 ± 0.222)	0.0010
p-value (vs healthy control)	< 0.001	< 0.001	

Data are expressed as median, minimum-maximum (and mean ± SD). Body composition analysis shows that BCM and fat mass are significantly lower in both the TGR and DGR groups compared to healthy controls. BCM tends to be lower in the TGR group than in the DGR group, although this difference is not significant. Fat mass is significantly lower in the TGR group.

Table 5 Comparison of early- and latter-term groups

	early-term group	latter-term group	p-value
DGR	n = 35	n = 73	
Body weight (kg)	54.7, 40.4-78.6 (55.4 ± 9.53)	63.7, 32.5-73.8 (54.9 ± 11.0)	0.997
Fat mass (proportion of the healthy control)	0.575, 0.179-1.413 (0.659 ± 0.308)	0.685, 0.047-1.617 (0.745 ± 0.342)	0.198
BCM (proportion of the healthy control)	0.965, 0.783-1.152 (0.953 ± 0.083)	0.932, 0.681-1.424 (0.945 ± 0.126)	0.414
Low BCM	42.9% (n = 15)	57.5% (n = 42)	0.153
TGR	n = 7	n = 30	
Body weight (kg)	46.5, 43.3-65.7 (49.5 ± 8.20)	52.2, 31.1-73.4 (51.0 ± 9.28)	0.485
Fat mass (proportion of the healthy control)	0.316, 0.179-0.599 (0.323 ± 0.136)	0.556, 0.180-0.886 (0.548 ± 0.2189)	0.015
BCM (proportion of the healthy control)	0.974, 0.852-1.045 (0.967 ± 0.070)	0.912, 0.640-1.162 (0.909 ± 0.120)	0.201
Low BCM	28.6% (n = 2)	70.0% (n = 21)	0.042

Data are expressed as median, minimum-maximum (and mean ± SD). In the DGR group, no significant differences are observed between the early- and latter-term groups for any parameters. Conversely, in the TGR group, fat mass is significantly higher, and there are significantly more low-BCM patients in the latter-term group.

Discussion

1. Body cell mass

BCM reflects nutritional status and has recently been reported as a useful parameter for assessing various diseases. Kawaguchi et al[10] reported that BCM as a percentage of body weight was about 60% in healthy adults, but only 54.3% ± 6.9% in patients with chronic gastrointestinal disease and 50.9% ± 4.5% in patients with liver cirrhosis. Kaido et al[11] reported that, in liver transplant patients, those with a pretransplant BCM below the standard range had a higher risk of serious infections and death post-transplant. The usefulness of BCM measurements has also been reported in many conditions, such as head and neck cancer, gastrointestinal disease, chronic renal failure, and obesity[11)~16)]. BCM measurements are conventionally based on total body potassium, and BCM can also be measured by 40 K radioisotope counting. However, BIA, which delivers superior convenience, noninvasiveness, and speed, has come into use in recent years.

2. Postgastrectomy changes

The present study showed that body weight decreased after gastrectomy. In particular, body weight decreased more after TGR than after DGR. BCM was also lower in both the DGR and TGR groups than in healthy controls, but tended to be even lower in the TGR group. This indicates that malnutrition is more likely after TGR. In addition, fat mass was significantly lower in the TGR group. Malnutrition and reduced fat mass are known to occur after TGR, primarily due to decreased gastric reservoir function. According to Noguchi et al[17], dietary caloric intakes in postoperative gastric cancer patients are 1,326 ± 442 kcal/day and 1,020 ± 391 kcal/day in DGR and TGR patients, respectively. These values, particularly in TGR patients, are lower than normal values in healthy adults. Body fat provides a stored energy source within the body; therefore, when caloric intake decreases, fats are consumed, and body fat mass consequently decreases. Changes in ghrelin levels have recently been proposed as another cause of postgastrectomy malnutrition and reduced fat mass. Ghrelin is a hormone that stimulates the appetite and promotes fat accumulation; however, serum ghrelin levels are low from the early postoperative stage in postoperative gastric cancer patients[18][19]. Meanwhile, ghrelin decreases are modest in DGR patients compared to TGR patients[20]. Thus, TGR patients are thought to be particularly susceptible to malnutrition and reduced fat mass. The present findings were consistent with those of previous reports.

3. Long-term changes

In the present study, in the TGR group, BCM tended to be lower in the long-term group, and the proportion of patients with low BCM was also significantly higher in the long-term group. In addition, fat mass was lower than in healthy controls, but it was still significantly higher in the long-term group. On the other hand, in the DGR group, BCM and fat mass did not significantly differ between the short- and long-term groups. This finding suggests that, over a long period in the TGR group, fat mass, which causes obesity, again increased, whereas BCM, a nutritional marker, further decreased. In other words, body composition over a long-term period is more likely to show changes associated with malnutrition after TGR than after DGR.

Although the present study was unable to investigate the causes of this difference in long-term body composition depending on gastrectomy type, there are two likely mechanisms: the effects of reconstruction method, and increased intestinal pH. With Roux-en-Y reconstruction, which is commonly used in TGR patients, duodenal bypass results in insufficient mixing of food with bile and pancreatic juices, and nutrient absorption decreases[21][22]. With regard to intestinal pH, the absence of gastric acid secretion after TGR causes intestinal pH to rise, which leads to overgrowth of enteric bacteria and changes in small intestinal mucosal function, impairing absorption[23][24]. By these mechanisms, absorption of essential nutrients is prevented in TGR patients, who are therefore more susceptible to long-term malnutrition than DGR patients.

The present study compared a short-term and a long-term group with less than 2 years or 2 or more years of follow-up, respectively, after gastrectomy for gastric cancer and investigated long-term changes in body composition. Although postgastrectomy body composition analyses using BIA have been reported[25]~[27], the majority of those studies conducted measurements within 2 years after surgery, and few examined long-term changes after 2 years. To the best of our knowledge, no studies of postgastrectomy BCM have been conducted to date in or outside Japan, and the present study thus offers new insight regarding postgastrectomy nutritional status.

The present study did not analyze preoperative body composition. Conventionally, comparisons of pre- and postoperative data are required when investigating surgery-related changes; however, this necessitates an extensive study period. In the present study, existing values for healthy adults were used as control values. The present method was also used by Nakahara et al[28], who conducted a comparative investigation of BMI measurements and blood test results in 103 patients with a history of gastrectomy classified into five groups based on length of time since surgery. With regard to postgastrectomy patient characteristics, the present investigation had sufficient validity. However, changes in postgastrectomy nutritional status in the present study were not rigorously evaluated. In addition, in terms of the background characteristics of the DGR and TGR group patients, postoperative follow-up was longer in the TGR group. This was attributed to a prolonged observation period in the TGR group due to reasons such as more time being needed for postoperative recovery and long-term malnutrition. In other words, there may have been selection bias between the DGR and TGR groups in the present study. Based on the above, a prospective study in which the preoperative BCM is measured and long-term rates of change in BCM are measured is warranted in the future.

Sarcopenia has received increasing attention in recent years, and sarcopenia as proposed by Rosenberg in 1989[29] now has several definitions. Sarcopenia as a concept, although not unified, generally refers to a "loss of muscle mass that occurs with aging" in elderly patients. In addition, Baumgartner in 2000 described "sarcopenic obesity"[30], which, in addition to a loss of muscle mass, also includes an increase in fat mass. Sarcopenic obesity is included within the concept of sarcopenia, but indicates further progression of sarcopenia due to the influence of cytokines produced by fat tissue[31][32]. Based on the present results, over a long-term period after TGR, BCM tended to decrease, and fat mass tended to increase. Because BCM correlates strongly with skeletal muscle[33], the present results suggest that sarcopenia may more readily progress long-term after TGR than after DGR. Given the increasing number of elderly postgastrectomy patients, further studies are needed.

Conclusion

Measurement of body weight in patients after gastrectomy has traditionally been widely used to conveniently evaluate postoperative nutritional status. However, the present study demonstrates that the changes in body composition occurring in postgastrectomy patients may be overlooked by relying on changes in body weight alone. To more accurately evaluate nutritional status after gastrectomy, body composition must be measured and analyzed. Long-term changes in body composition are less likely after DGR, whereas body composition after TGR is more likely to change over time, more readily leading to malnutrition after a long period. BIA is superior in terms of convenience, noninvasiveness, and speed, and it appears useful for evaluating nutritional status in postgastrectomy patients.

The authors have no conflicts of interest to declare.

References

1) **Cruz-Jonetoft AJ, Baeyens JP, Bauer JM et al**: Sarcopenia European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing **39**: 412–423, 2010
2) **Thomasset A**: Measurement of the extracellular fluid volume by the electro-chemical method. Biophsical significance of 1 kilocycle impedance of the human body. Lyon Med **214**: 131–143, 1965
3) **Hoffer EC, Meador CK, Simpson DC**: Correlation of whole-body impedance with total body water volume. J Appl Physiol **27**: 531–534, 1969
4) **Miyake N, Tanaka A, Eguchi M et al**: Reference Deta of Multi Frequencies Bioelectric Impedance Method in Japanese. Anti-Aging Med **6** (3): 10–14, 2009
5) **Bedogni G, Malavolti M, Severi S et al**: Accuracy of an eight-point tactile-electrode impedance method in the assessment of total body water. Eur J Clin Nutr **56**: 1143–1148, 2002
6) **Shafer KJ, Siders WA, Johnson LK et al**: Validity of segmental multiple-frequency bioelectrical impedance analysis to estimate body composition of adults across a range of body mass index. Nutrition **25**: 25–32, 2009
7) **Ling CH, de Craen AJ, Slagboom PE et al**: Accuracy of direct segmental multi-frequency bioimpedance analysis in the assessment of total body and segmental body composition in middle-aged adult population. Clin Nutr **30**: 610–615, 2011
8) **Jensky-Squires NE, Dieli-Conwright CM, Rossuello A et al**: Validity and reliability of body composition analysers in children and adults. Br J Nutr **100**: 859–865, 2008
9) **Moore FD, Olesen KH, McMurray JD et al**: The body cell mass and its supporting environment. *In* Body Composition in Health and Disease, pp173–223, W.B. Saunders, Philadelphia (1963)
10) **Kawaguchi T, Taniguchi E, Itou M et al**: Body cell mass is a useful parameter for assessing malnutrition and severity of disease in non-ascitic cirrhotic patients with hepatocellular carcinoma or esophageal varices. Int J Mol Med **22**: 589–594, 2008
11) **Kaido T, Mori A, Oike F et al**: Impact of pretrans-

plant nuturitional status in patients undergoing transplantation. Hepatogastroenterology **57** (104): 1489–1492, 2010
12) **Kaido T, Mori A, Ogura Y et al**: Pre-and perioperative factors affecting infection after living donor liver transplantation. Nutrition **28**: 1104–1108, 2012
13) **Bozzetti F**: Nutrition support in patients with cancer. *In* Artificial Nutrition Support in Clinical Practice, pp639–680, Greenwich Medical Media, London, San Francisco (2001)
14) **Małecka-Massalska T, Smolen A, Morshed K**: Extracellular-to-body cell mass ratio and subjective global assessment in head-and-neck cancers. Curr Oncol **21**: e62–e66, 2014
15) **Friedrich AE, Damms-Machado A, Meile T et al**: Laparoscopic sleeve gastrectomy compared to a multidisciplinary weight loss program for obesity—effects on body composition and protein status. Obes Surg **23** (12): 1957–1965, 2013
16) **Hyun SH, Choi JY, Cho JH et al**: Assessment of fluid and nutritional status using multifrequency bioelectrical impedance analysis in peritoneal dialysis patients. Blood Purif **37**: 152–162, 2014
17) **Noguchi Y, Tsuburaya A, Makino T et al**: Metabolic alterations in totally gastrectomised patients-caloric intake and energy consumption. Asian J Surg **15**: 97–102, 1992
18) **Seto Y, Miura H, Wada I et al**: What is ghrelin for gastric cancer? Jpn J Cancer Chemother **37** (8): 1429–1435, 2010
19) **Takachi K, Doki Y, Ishikawa O et al**: Postooperative ghrelin lebels and delayed recovery from body weight loss after distal or total gastrectomy. J Surg Res **130** (1): 1–7, 2006
20) **Joen TY, Lee S, Kim HH et al**: Changes in plasma ghrelin concentration immediately after gastrectomyin patients with early gastric cancer. J Clin Endocrinol Metab **89**: 5392–5396, 2004
21) **Walthrer B, Clementsson C, Vallgren S et al**: Fat malabsorption in patients before and after total gastrectomy, studied by the triolein breath test. Scand J Gastroenterol **24**: 309–314, 1989
22) **Momose R**: Study of bone metabolism, intestinal absorption and anemia in long course after total gastrectomy. Jpn J Gastroenterol Surg **24** (3): 779–787, 1991
23) **Ishibashi Y, Kashiwagi H**: Postgastrectomy metabolic bone disease. Clin Gastroenterol **24**: 1457–1463, 2009
24) **Tsujimono H, Ichikawa T**: Nutrition disorders in postgastretcomy patients. Clin Gastroenterol **24**: 1451–1456, 2009
25) **Abdiev S, Kodera Y, Fujiwara M et al**: Nutritional recovery after open and laparoscopic gastrectomies. Gastric Cancer **14**: 144–149, 2011
26) **Kiyama T, Mizutani T, Okuda T et al**: Postoperative changes in body composition after gastrectomy. J Gastrointest Surg **9**: 313–319, 2005
27) **Hayashi M**: Significance of bioelectrical impedance analysis (BIA) for gastrointestinal surgery. Med J Kinki Univ **20** (2): 211–222, 1995
28) **Nakahara K, Kanetaka T, Adachi A et al**: The nutritional effects of parietial gastrectomy more than 20 years after surgery. Teishin Igaku **43**: 681–685, 1991
29) **Rosenberg IH**: Summary comments. Am J Clin Nutr **50**: 1231–1233, 1989
30) **Baumgartner RN**: Body composition in healthy aging. Ann NY Acad Sci **904**: 437–448, 2000
31) **Kohara K**: Sarcopenic obesity in aging population: current status and future directions for research. Endocrine **45** (1): 15–25, 2014
32) **Vincent HK, Raiser SN, Vincent KR**: The aging musculoskeletal system and obesity-related considerations with exercise. Aging Res Rev **11** (3): 361–373, 2012
33) **Kaido T, Uemoto S**: Direct segmental multifrequency bioelectrical impedance analysis is useful to evaluate sarcopenia. Am J Transplant **13**: 2506–2507, 2013

胃切除後の体成分の変化—幽門側胃切除と胃全摘を比較して—

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胃切除後に低栄養を認めることは，以前より知られている．また，加齢に伴う筋肉量の減少という「サルコペニア」の概念は，現在注目を集めている．今回我々は，当科で胃切除を行った患者に対して生体電気インピーダンス法を用いた体成分分析を行い，胃切除後患者の体成分の特徴を検討した．対象は胃癌に対して当科で幽門側胃切除，もしくは胃全摘を施行した患者145人とし，対象患者を幽門側胃切除群（DGR群108人）と胃全摘群（TGR群37人）に分け，両者の栄養状態を比較した．測定項目は，術前後の体重，脂肪量，体細胞量（BCM）とした．BCMはMooreらによって提唱された概念で，栄養状態を反映する量として，近年，その有用性が様々な疾患で報告されている．さらに我々は，対象患者を術後経過期間が24ヵ月未満の早期群と，24ヵ月以降の後期群に分け，両者の比較を行い，長期的な栄養状態の変化も検討した．結果，体重減少率はDGR群より，TGR群の方が有意に大きかった．脂肪量はDGR群よりTGR群の方が有意に低かった．BCMは，有意差を認めなかったがDGR群よりTGR群の方が低い傾向にあった．早期群と後期群を比較した結果は，DGR群においては，早期群と後期群の間に各項目で有意な違いを認めなかった．しかし，TGR群では，早期群に比較し後期群では脂肪量が有意に高値であった．また，TGR群では，BCMは後期群の方が低い傾向にあり，BCMが低下している症例（BCMが健常人より5%以上低下している症例）の割合は，後期群の方が有意に高かった．今回の結果より，幽門側胃切除では，長期的な変化は起こりにくい一方で，胃全摘では，長期的に脂肪が上昇し，BCMは低下する傾向がわかった．BCMは栄養状態を反映すると共に，筋肉量と相関することが報告されており，幽門側胃切除後に比べて，胃全摘後では長期的に低栄養状態になりやすく，またサルコペニアの進行が速いことが示唆された．