ISSN 1007-9327 (print)
ISSN 2219-2840 (online)

World Journal of *Gastroenterology*

World J Gastroenterol 2022 August 28; 28(32): 4475-4743

Published by Baishideng Publishing Group Inc

World Journal of Gastroenterology

Contents

Weekly Volume 28 Number 32 August 28, 2022

REVIEW

MINIREVIEWS

ORIGINAL ARTICLE

Basic Study

World Journal of Gastroenterology

Weekly Volume 28 Number 32 August 28, 2022

Contents

ABOUT COVER

Editorial Board Member of *World Journal of Gastroenterology*, PhD, MD, Associate Professor in Infectious Diseases, Department of Mental Health and Public Medicine, University of Campania "Luigi Vanvitelli", Naples 80130, Italy. caterina.sagnelli@unicampania.it

AIMS AND SCOPE

The primary aim of *World Journal of Gastroenterology* (*WJG*, *World J Gastroenterol*) is to provide scholars and readers from various fields of gastroenterology and hepatology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online. *WJG* mainly publishes articles reporting research results and findings obtained in the field of gastroenterology and hepatology and covering a wide range of topics including gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, gastrointestinal oncology, and pediatric gastroenterology.

INDEXING/ABSTRACTING

The *WJG* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports, Index Medicus, MEDLINE, PubMed, PubMed Central, Scopus, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database. The 2022 edition of Journal Citation Reports® cites the 2021 impact factor (IF) for *WJG* as 5.374; IF without journal self cites: 5.187; 5-year IF: 5.715; Journal Citation Indicator: 0.84; Ranking: 31 among 93 journals in gastroenterology and hepatology; and Quartile category: Q2. The *WJG*'s CiteScore for 2021 is 8.1 and Scopus CiteScore rank 2021: Gastroenterology is 18/149.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Yu-Xi Chen*; **Production Department Director:** *Xu Guo*; **Editorial Office Director:** *Jia-Ru Fan*.

NAME OF JOURNAL
World Journal of Gastroenterology

ISSN
ISSN 1007-9327 (print) ISSN 2219-2840 (online)

LAUNCH DATE
October 1, 1995

FREQUENCY
Weekly

EDITORS-IN-CHIEF
Andrzej S Tarnawski

EDITORIAL BOARD MEMBERS
http://www.wjgnet.com/1007-9327/editorialboard.htm

PUBLICATION DATE
August 28, 2022

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

World Journal of Gastroenterology

Submit a Manuscript: https://www.f6publishing.com

World J Gastroenterol 2022 August 28; 28(32): 4508-4515

DOI: 10.3748/wjg.v28.i32.4508

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

MINIREVIEWS

Assessment of physical stress during the perioperative period of endoscopic submucosal dissection

Daisuke Chinda, Tadashi Shimoyama

Specialty type: Gastroenterology and hepatology

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B, B, B
Grade C (Good): 0
Grade D (Fair): D
Grade E (Poor): 0

P-Reviewer: Feng JB, China; He CY, China; Li XB, China; Linghu EQ, China

Received: January 14, 2022
Peer-review started: January 14, 2022
First decision: April 16, 2022
Revised: April 28, 2022
Accepted: July 31, 2022
Article in press: July 31, 2022
Published online: August 28, 2022

Daisuke Chinda, Tadashi Shimoyama, Department of Gastroenterology, Hirosaki University Graduate School of Medicine, Hirosaki 036-8562, Japan

Daisuke Chinda, Division of Endoscopy, Hirosaki University Hospital, Hirosaki 036-8563, Japan

Tadashi Shimoyama, Department of Internal Medicine, Aomori General Health Examination Center, Aomori 030-0962, Japan

Corresponding author: Tadashi Shimoyama, FACG, MD, PhD, Director, Department of Internal Medicine, Aomori General Health Examination Center, 2-12-19 Tsukuda, Aomori 030-0962, Japan. tsimo@hirosaki-u.ac.jp

Abstract

The advantage of endoscopic submucosal dissection (ESD) is that it is less invasive than surgery. ESD is one of the best treatments for older patients as surgery in this age group of patients is difficult. However, it is unclear how much lower the physical stress of ESD is compared with that of surgery. Thus, objective methods are required to assess physical stress in patients who have undergone ESD. The current review of ESD aimed to summarize the recent advancements in the assessment of physical stress during the perioperative period, focusing on changes in energy metabolism and serum opsonic activity (SOA). Based on metabolic changes, resting energy expenditure (REE) was measured using an indirect calorimeter. The stress factor calculated from the REE and the basal energy expenditure computed using the Harris-Benedict equation can be used to assess physical stress. SOA was assessed using the chemiluminescence method, wherein the use of chemiluminescent probes (*i.e.*, lucigenin and luminol) allowed quantification of reactive oxygen species generated by neutrophils. Using an auto luminescence analyzer, the results were evaluated based on the maximum light emission and area under the emission curve. These quantifiable results revealed the minimal invasiveness of ESD.

Key Words: Physical stress; Endoscopic submucosal dissection; Indirect calorimeter; Resting energy expenditure; Chemiluminescence; Serum opsonic activity

Core Tip: Concerning the degree of physical invasiveness of patients before and after endoscopic submucosal dissection (ESD), assessment methods based on changes in energy metabolism using an indirect calorimeter and serum opsonic activity (SOA) measured by lucigenin- and luminol-dependent chemiluminescence are useful and easy to measure. During the perioperative period of ESD, the increase in resting energy expenditure and stress factor were lower than those reported for surgery, and SOA changes involved a minor increase in the production of lower-toxicity reactive oxygen species. These assessment methods demonstrated that the physical stress of ESD is less invasive than that of surgery.

Citation: Chinda D, Shimoyama T. Assessment of physical stress during the perioperative period of endoscopic submucosal dissection. *World J Gastroenterol* 2022; 28(32): 4508-4515
URL: https://www.wjgnet.com/1007-9327/full/v28/i32/4508.htm
DOI: https://dx.doi.org/10.3748/wjg.v28.i32.4508

INTRODUCTION

Endoscopic treatment for early-stage cancer is indicated when there is a very low probability of lymph node metastasis and when curative en bloc resection is possible[1-3]. Endoscopic submucosal dissection (ESD) is widely used for early gastrointestinal cancer because it is a safe and effective treatment that can preserve function[4-7]. In addition, ESD has a higher rate of en bloc curative resection than endoscopic mucosal resection[8]. Therefore, ESD enables a more precise histopathological diagnosis. ESD is also performed on early gastrointestinal cancer lesions, where surgery was previously common, and often results in a curative resection[9,10]. The most significant advantage for patients is that the physical stress associated with ESD is less than that associated with surgery. From the above, ESD is one of the best treatment options for older patients who are considered difficult to operate on[11-14]. However, it is unclear how much lower the physical stress of ESD is than that of surgery; thus, objective methods are required to assess the physical stress of patients who have undergone ESD. With the increase in the number of older people, the number of patients undergoing ESD for early intestinal cancer is increasing. With advances in endoscopic diagnosis, intestinal cancer will be detected at an earlier stage, and more patients will be treated with ESD. Therefore, it is desirable to develop a method that can evaluate physical stress, even in older patients who are subjected to ESD.

Moreover, ESD is an endoscopic surgery performed on various gastrointestinal tracts, and it is expected that physical stress will differ depending on the organ involved. There is a difference between gastric and colorectal ESD in terms of both technical difficulty and perioperative management. In our facility, because gastric ESD is performed orally, patients fasted after dinner the night before ESD and underwent ESD with pethidine hydrochloride and midazolam or diazepam. In contrast, colorectal ESD requires bowel cleansing prior to colonoscopy. During fasting for ESD, patients are supplied with a drip transfusion and undergo whole bowel irrigation the previous evening and the day of ESD. As patients may need to change their posture to make the ESD procedure easier, colorectal ESD is performed in the awakened state with the analgesic pethidine hydrochloride. Thus, it can be presumed that physical stress in the perioperative period of gastric ESD differs from that of colorectal ESD. Therefore, an assessment method that can compare the physical stress of ESD procedures for different organs is needed.

The current review aimed to summarize the recent advances in physical stress assessment during the perioperative period of ESD, focusing on the changes in energy metabolism and serum opsonic activity (SOA). Additionally, the physical stresses during the perioperative period of gastric and colorectal ESD in comparison to surgery are discussed.

EARLY INVESTIGATIONS

Serum levels of interleukin (IL)-6, IL-8, tumor necrosis factor-α, and C-reactive protein fluctuate during the perioperative period[15-18]. Myre *et al*[19] reported that high and low doses of remifentanil affect the release of catecholamines (norepinephrine and epinephrine) differently during laparoscopic fundoplication. However, there have been no effective blood tests to assess physical invasiveness to date.

A report on ESD in the early stages of gastric cancer points out that increased salivary amylase activity in patients may indicate intraoperative stress[20]. However, this change is a hyperacute reaction of the endocrine system, and it is not possible to assess the physical invasion of ESD throughout the perioperative period.

ASSESSMENT OF PHYSICAL STRESS BY ENERGY METABOLISM

Surgical invasion alters metabolism, and the increased physical stress causes an increase in the patient's energy requirements[21-23]. The patient is subject to two principal metabolic responses: The responses to starvation and stress[24-26]. In addition, the energy requirements are associated with a degree of physical invasiveness[27].

Therefore, changes in resting energy expenditure (REE) measured using an indirect calorimeter can be used to evaluate physical stress. An indirect calorimeter measures the amount of oxygen consumed and the amount of carbon dioxide produced during metabolism and the energy consumption[21]. On the other hand, basal energy expenditure (BEE) is calculated using the Harris-Benedict equation based on the patient's height and body weight. It reflects the energy requirements of each patient[28]. Previous studies have compared BEE during the surgical perioperative period[29-32], but there are few reports using REE measurements. It is presumed that the measurement of REE is more complicated than that of BEE, and few facilities have the calorimeter required for the measurement. On the other hand, the greatest advantage of this method is acceptability for the patients. Because these methods require only exhalation, the patient can rest on the bed, and the measurement time is approximately 5 min each time.

The stress factor (SF) can be done by measured energy expenditure divided by the predicted energy expenditure using the Harris-Benedict equation and the active factor and assess the perioperative physical stress of ESD, even in older patients. According to Long's method[28], the total energy expenditure is defined as the product of BEE, SF, and the activity factor, and it is theoretically the same as the REE measured at rest. Since the activity factor on the day of ESD is the same as that on postoperative day (POD) 1, the SF on POD 1 can be calculated by setting SF on the day to be 1.0[33,34]. From the above, SF is a marker indicating the degree of hypermetabolic state[33,34]. The values of SFs are recognized as 1.1 for low invasiveness, 1.2 for medium invasiveness, and 1.8 for high invasiveness [28], and these values are used as indicators to determine perioperative energy management.

As shown in Table 1, the changes in the perioperative REE and SFs differed between gastric and colorectal ESD[33,34]. Regarding gastric ESD, the REE and REE/BEE increased significantly from the day of gastric ESD to POD 1. The SF for gastric ESD on POD 1 was calculated as 1.07, setting the SF on the day to 1.0[33]. There was no significant difference in REE on the day of ESD and POD 1 for colorectal ESD. However, REE/BEE was significantly higher on POD 1 than on the day of ESD. The SF for colorectal ESD on POD 1 was calculated as 1.06[34].

Regarding the perioperative REEs in surgery for gastric and colorectal cancer, Fredrix *et al*[26] reported that REE on the 7th and 8th PODs was 1.069% compared to the preoperative value. With respect to the SF on the third day after the surgery, Inoue *et al*[35] reported it was 1.4 for moderate invasive surgery such as subtotal gastrectomy or colectomy, and 1.6 for highly invasive surgery such as total gastrectomy. In our previous studies, REEs and SFs were evaluated on POD 1 when the patient was presumed to have the highest degree of physical and psychological stress; however, they remained low compared to those for surgeries[33,34].

ASSESSMENT OF PHYSICAL STRESS BY SOA

Opsonization is a humoral immune response involving the complement system that facilitates the capture and uptake of foreign substances by neutrophils and other phagocytes. An increase in SOA causes neutrophil activation and stimulates the secretion of reactive oxygen species (ROS)[36,37], which is associated with physical stress[38-40]. Among ROS, superoxide anions (O^{2-}) and hydrogen peroxide (H_2O_2) induce DNA fragmentation in cells, causing inflammation and tissue damage[37]. In sports medicine, there have been many reports that physical stress is evaluated by changes in SOA, an index of the immune capacity of non-specific neutrophils[39-41].

The chemiluminescence method is easy to perform, requiring only a blood sample and enabling the quantification of ROS produced by neutrophils[38-40]. This method is useful because the collected biological samples can be measured simultaneously under the same conditions. It detects ROS using chemiluminescent probes (*i.e.*, lucigenin and luminol).

O^{2-} is produced by neutrophils. Its formation is mediated by NADPH oxidase, which is activated by phagocytosis, and converted to H_2O_2 by superoxide dismutase[36,37]. Furthermore, each ROS has a different oxidation potential. When neutrophils release azurophilic granules containing myeloperoxidase (MPO), H_2O_2 reacts with Cl^- to produce hypochlorous acid (HOCl), which is a more powerful oxidant than H_2O_2[36,37]. Lucigenin is associated with the detection of O^{2-}, whereas luminol reflects the total amount of ROS produced by MPO, including HOCl[36,37]. Thus, the oxidative stress measured by luminol-dependent chemiluminescence is generally considered more toxic as it reflects all types of ROS in a sample.

To measure SOA in the peripheral blood, zymosan, an activator of the alternative complement pathway found in *Saccharomyces cerevisiae*, was opsonized in serum samples of patients who underwent ESD. Lucigenin- and luminol-dependent chemiluminescence were used to detect and quantify the ROS secreted by the neutrophils of a healthy volunteer against these opsonized zymosan molecules[36,37,

Table 1 Perioperative changes in resting energy expenditure, resting energy expenditure/basal energy expenditure, and stress factors by endoscopic submucosal dissection

	ESD preoperative state	ESD postoperative state
Gastric cancer		
REE (kcal)	1170.3 ± 209.0	1238.4 ± 235.5[c]
REE/BEE	0.96 ± 0.11	1.03 ± 0.14[c]
Stress factor		1.07
Colorectal cancer		
REE (kcal)	1107.0 ± 204.4	1139.9 ± 185.2[c]
REE/BEE	0.96 ± 0.12	1.00 ± 0.13[c]
Stress factor		1.06

[c]$P < 0.001$ *vs* endoscopic submucosal dissection (ESD) preoperative state.

Data are presented as mean ± SD. The stress factor on ESD in the postoperative state was computed by setting the stress factor on the day of ESD to be 1.0. ESD: Endoscopic submucosal dissection; REE: Resting energy expenditure; BEE: Basal energy expenditure.

42]. The emission curve measured by the chemiluminescence method was evaluated using an autoluminescence analyzer, focusing on the peak height and the area under the curve. For each measurement, the serum of a healthy volunteer was used as the standard value for ROS production. The results of the chemiluminescence method were calculated as a percentage compared to standard serum levels[36,37,42]. Changes in SOA, measured by the chemiluminescence method, are valuable in assessing the physical stress associated with endoscopic treatment of early-stage cancer[42].

As shown in Table 2, a significant increase in the peak height and area under the curve of lucigenin-dependent chemiluminescence was observed for gastric ESD on POD 1 and 4. Both of these percentages tended to decrease on POD 4 compared with those on POD 1. However, there was no significant increase in these parameters for luminol-dependent chemiluminescence on POD 1 and 4. In contrast, for colorectal cancer, the peak height and area under the curve of lucigenin-dependent chemiluminescence showed no significant difference in POD 1 but a significant increase in POD 4 compared with those on the day of ESD. Furthermore, no significant changes in these parameters were noted on luminol-dependent chemiluminescence during the perioperative period, similar to gastric ESD[42]. In contrast, previous studies on patients undergoing gastrointestinal surgery with different degrees of surgical stress found higher SOA measured by luminol-dependent chemiluminescence[43,44]. The difference in SOA between ESD and surgery suggests that ESD is less invasive.

Based on the results of the chemiluminescence method, changes in SOA during the perioperative period of ESD were associated with a slight increase in the production of less toxic ROS. The difference in the peak height of SOA between gastric and colorectal ESD, measured by lucigenin-dependent chemiluminescence, may be related to the difference in stimulation to post-ESD ulcers. Both gastric and colorectal ESD patients started eating meals 2 d after the procedure. Post-gastric ESD ulcers are immediately stimulated by gastric acid and oral bacteria. In cases of colorectal ESD, feces are defecated by intestinal tract-cleaning compositions, and the population of gut microbiota is markedly reduced before ESD. Therefore, SOA may have increased significantly on POD 4 because the post-ESD ulcer is stimulated by feces after resuming meals.

CONCLUSION

The current review summarizes the methods to assess the physical invasiveness of ESD in patients based on changes in REE measured using an indirect calorimeter and SOA measured by the chemiluminescence method. These methods are easy to perform and non-invasive, even in older patients. In addition, the results showed that changes in perioperative physical stress differed between gastric and colorectal ESD. The increases in perioperative REE and SF after ESD were lower than those reported for surgery. The perioperative changes in SOA after ESD were associated with slight increases in the production of less toxic ROS. These findings suggest that ESD does not cause significant physical stress.

In recent years, laparoscopic and less-invasive surgeries have become widespread. Further multicenter studies are needed to compare the changes in REE and SFs between ESD and less-invasive surgeries. There are also new procedures for endoscopic therapies, such as peroral endoscopic myotomy (POEM) and laparoscopic endoscopic cooperative surgery (LECS). In the future, it will be important to evaluate the physical stress of these procedures as well.

Table 2 Endoscopic submucosal dissection perioperative changes in serum opsonic activity measured by lucigenin- and luminol-dependent chemiluminescence

	The day of ESD	POD1	POD4
Gastric cancer			
Lucigenin			
Peak height (%)	100.6	106.3[b]	105.9[b]
	(71.4-178.5)	(78.5-282.4)	(77.6-214.4)
Area under the curve (%)	98.4	105.6[b]	103.5[b]
	(48.7-184.7)	(64.8-265.3)	(66.0-222.8)
Luminol			
Peak height (%)	98.4	100.1	99.6
	(62.7-168.3)	(63.6-199.2)	(69.7-186.6)
Area under the curve (%)	99.7	102.6	101.8
	(68.2-155.7)	(68.0-182.9)	(73.2-170.7)
Colorectal cancer			
Lucigenin			
Peak height (%)	102.3	105.2	105.3[a]
	(71.4-132.7)	(61.8-137.4)	(65.7-137.1)
Area under the curve (%)	99.4	101.9	102.6[a]
	(68.2-134.3)	(60.9-140.0)	(64.0-139.7)
Luminol			
Peak height (%)	97.3	100.2	99.9
	(70.9-132.5)	(76.6-132.0)	(74.9-134.7)
Area under the curve (%)	99.1	102.1	102.3
	(75.8-131.4)	(78.3-128.6)	(77.4-134.3)

[a]$P < 0.05$, [b]$P < 0.01$ *vs* the day of endoscopic submucosal dissection.
Data are expressed as median with interquartile range in parenthesis. ESD: Endoscopic submucosal dissection; POD: Postoperative day.

FOOTNOTES

Author contributions: Chinda D and Shimoyama T designed the review; Chinda D interpreted the data and drafted the manuscript; Shimoyama T critically revised the paper.

Supported by the Karoji Memorial Fund for Medical Research.

Conflict-of-interest statement: There are no conflicts of interest to report.

Country/Territory of origin: Japan

ORCID number: Daisuke Chinda 0000-0003-1690-5923; Tadashi Shimoyama 0000-0001-9615-0000.

Corresponding Author's Membership in Professional Societies: American Gastroenterological Association, No. 186311; American College of Gastroenterology, FACG.

S-Editor: Chen YL
L-Editor: A

P-Editor: Chen YL

REFERENCES

1 **Tanaka S**, Kashida H, Saito Y, Yahagi N, Yamano H, Saito S, Hisabe T, Yao T, Watanabe M, Yoshida M, Saitoh Y, Tsuruta O, Sugihara KI, Igarashi M, Toyonaga T, Ajioka Y, Kusunoki M, Koike K, Fujimoto K, Tajiri H. Japan Gastroenterological Endoscopy Society guidelines for colorectal endoscopic submucosal dissection/endoscopic mucosal resection. *Dig Endosc* 2020; **32**: 219-239 [PMID: 31566804 DOI: 10.1111/den.13545]

2 **Hashiguchi Y**, Muro K, Saito Y, Ito Y, Ajioka Y, Hamaguchi T, Hasegawa K, Hotta K, Ishida H, Ishiguro M, Ishihara S, Kanemitsu Y, Kinugasa Y, Murofushi K, Nakajima TE, Oka S, Tanaka T, Taniguchi H, Tsuji A, Uehara K, Ueno H, Yamanaka T, Yamazaki K, Yoshida M, Yoshino T, Itabashi M, Sakamaki K, Sano K, Shimada Y, Tanaka S, Uetake H, Yamaguchi S, Yamaguchi N, Kobayashi H, Matsuda K, Kotake K, Sugihara K; Japanese Society for Cancer of the Colon and Rectum. Japanese Society for Cancer of the Colon and Rectum (JSCCR) guidelines 2019 for the treatment of colorectal cancer. *Int J Clin Oncol* 2020; **25**: 1-42 [PMID: 31203527 DOI: 10.1007/s10147-019-01485-z]

3 **Ono H**, Yao K, Fujishiro M, Oda I, Uedo N, Nimura S, Yahagi N, Iishi H, Oka M, Ajioka Y, Fujimoto K. Guidelines for endoscopic submucosal dissection and endoscopic mucosal resection for early gastric cancer (second edition). *Dig Endosc* 2021; **33**: 4-20 [PMID: 33107115 DOI: 10.1111/den.13883]

4 **Tanoue K**, Fukunaga S, Nagami Y, Sakai T, Maruyama H, Ominami M, Otani K, Hosomi S, Tanaka F, Taira K, Kamata N, Yamagami H, Tanigawa T, Shiba M, Watanabe T, Fujiwara Y. Long-term outcome of endoscopic submucosal dissection for early gastric cancer in patients with severe comorbidities: a comparative propensity score analysis. *Gastric Cancer* 2019; **22**: 558-566 [PMID: 30382467 DOI: 10.1007/s10120-018-0889-8]

5 **Ryu SJ**, Kim BW, Kim BG, Kim JH, Kim JS, Kim JI, Park JM, Oh JH, Kim TH, Kim JJ, Park SM, Park CH, Song KY, Lee JH, Kim SG, Kim DJ, Kim W. Endoscopic submucosal dissection *vs* surgical resection for early gastric cancer: a retrospective multicenter study on immediate and long-term outcome over 5 years. *Surg Endosc* 2016; **30**: 5283-5289 [PMID: 27338583 DOI: 10.1007/s00464-016-4877-y]

6 **Dumoulin FL**, Hildenbrand R. Endoscopic resection techniques for colorectal neoplasia: Current developments. *World J Gastroenterol* 2019; **25**: 300-307 [PMID: 30686899 DOI: 10.3748/wjg.v25.i3.300]

7 **Kondo A**, de Moura EG, Bernardo WM, Yagi OK, de Moura DT, de Moura ET, Bravo JG, Yamazaki K, Sakai P. Endoscopy *vs* surgery in the treatment of early gastric cancer: Systematic review. *World J Gastroenterol* 2015; **21**: 13177-13187 [PMID: 26675093 DOI: 10.3748/wjg.v21.i46.13177]

8 **Xu X**, Wang T, Zheng Z, Chen X, Liu W, Sun C, Wang B. Endoscopic submucosal dissection for large colorectal epithelial neoplasms: A single center experience in north China. *Medicine (Baltimore)* 2017; **96**: e7967 [PMID: 28885349 DOI: 10.1097/MD.0000000000007967]

9 **Kim SG**, Ji SM, Lee NR, Park SH, You JH, Choi IJ, Lee WS, Park SJ, Lee JH, Seol SY, Kim JH, Lim CH, Cho JY, Kim GH, Chun HJ, Lee YC, Jung HY, Kim JJ. Quality of Life after Endoscopic Submucosal Dissection for Early Gastric Cancer: A Prospective Multicenter Cohort Study. *Gut Liver* 2017; **11**: 87-92 [PMID: 27282267 DOI: 10.5009/gnl15549]

10 **Kim YI**, Kim YA, Kim CG, Ryu KW, Kim YW, Sim JA, Yun YH, Choi IJ. Serial intermediate-term quality of life comparison after endoscopic submucosal dissection *vs* surgery in early gastric cancer patients. *Surg Endosc* 2018; **32**: 2114-2122 [PMID: 29067581 DOI: 10.1007/s00464-017-5909-y]

11 **Hirasaki S**, Tanimizu M, Nasu J, Shinji T, Koide N. Treatment of elderly patients with early gastric cancer by endoscopic submucosal dissection using an insulated-tip diathermic knife. *Intern Med* 2005; **44**: 1033-1038 [PMID: 16293912 DOI: 10.2169/internalmedicine.44.1033]

12 **Isomoto H**, Ohnita K, Yamaguchi N, Fukuda E, Ikeda K, Nishiyama H, Akiyama M, Ozawa E, Nakao K, Kohno S, Shikuwa S. Clinical outcomes of endoscopic submucosal dissection in elderly patients with early gastric cancer. *Eur J Gastroenterol Hepatol* 2010; **22**: 311-317 [PMID: 19494784 DOI: 10.1097/MEG.0b013e32832c61d7]

13 **Chang JW**, Jung DH, Park JC, Shin SK, Lee SK, Lee YC. Long-Term Outcomes and Prognostic Factors of Endoscopic Submucosal Dissection for Early Gastric Cancer in Patients Aged ≥75 Years. *Cancers (Basel)* 2020; **12** [PMID: 33142928 DOI: 10.3390/cancers12113222]

14 **Kim GH**, Choi KD, Ko Y, Park T, Kim KW, Park SY, Na HK, Ahn JY, Lee JH, Jung KW, Kim DH, Song HJ, Lee GH, Jung HY. Impact of Comorbidities, Sarcopenia, and Nutritional Status on the Long-Term Outcomes after Endoscopic Submucosal Dissection for Early Gastric Cancer in Elderly Patients Aged ≥ 80 Years. *Cancers (Basel)* 2021; **13** [PMID: 34298811 DOI: 10.3390/cancers13143598]

15 **Nishiguchi K**, Okuda J, Toyoda M, Tanaka K, Tanigawa N. Comparative evaluation of surgical stress of laparoscopic and open surgeries for colorectal carcinoma. *Dis Colon Rectum* 2001; **44**: 223-230 [PMID: 11227939 DOI: 10.1007/BF02234297]

16 **Wang G**, Jiang Z, Zhao K, Li G, Liu F, Pan H, Li J. Immunologic response after laparoscopic colon cancer operation within an enhanced recovery program. *J Gastrointest Surg* 2012; **16**: 1379-1388 [PMID: 22585532 DOI: 10.1007/s11605-012-1880-z]

17 **Benoit O**, Faron M, Margot N, Creavin B, Debove C, Tiret E, Parc Y, Lefevre JH. C-Reactive Protein Values After Colorectal Resection: Can We Discharge a Patient With a C-Reactive Protein Value >100? *Dis Colon Rectum* 2019; **62**: 88-96 [PMID: 30451748 DOI: 10.1097/DCR.0000000000001216]

18 **Ding S**, Ma H, Wang G, Yu Z, Li K, Huang A. Effect of Remifentanil Combined Anesthesia on Cytokines and Oxidative Stress in Patients undergoing Laparoscopic Surgery for Colon Cancer. *J Coll Physicians Surg Pak* 2019; **29**: 8-11 [PMID: 30630560 DOI: 10.29271/jcpsp.2019.01.8]

19 **Myre K**, Raeder J, Rostrup M, Buanes T, Stokland O. Catecholamine release during laparoscopic fundoplication with high and low doses of remifentanil. *Acta Anaesthesiol Scand* 2003; **47**: 267-273 [PMID: 12648191 DOI:

10.1034/j.1399-6576.2003.00073.x]

20 **Uesato M**, Nabeya Y, Akai T, Inoue M, Watanabe Y, Kawahira H, Mamiya T, Ohta Y, Motojima R, Kagaya A, Muto Y, Hayashi H, Matsubara H. Salivary amylase activity is useful for assessing perioperative stress in response to pain in patients undergoing endoscopic submucosal dissection of gastric tumors under deep sedation. *Gastric Cancer* 2010; **13**: 84-89 [PMID: 20602194 DOI: 10.1007/s10120-009-0541-8]

21 **Yatabe T**, Kitagawa H, Yamashita K, Hanazaki K, Yokoyama M. Energy expenditure measured using indirect calorimeter after minimally invasive esophagectomy in ventilated postoperative patients. *Asia Pac J Clin Nutr* 2014; **23**: 555-559 [PMID: 25516312 DOI: 10.6133/apjcn.2014.23.4.20]

22 **Kalnins D**, Pencharz PB, Grasemann H, Solomon M. Energy expenditure and nutritional status in pediatric patients before and after lung transplantation. *J Pediatr* 2013; **163**: 1500-1502 [PMID: 23870785 DOI: 10.1016/j.jpeds.2013.05.063]

23 **Ferreira LG**, Santos LF, Anastácio LR, Lima AS, Correia MI. Resting energy expenditure, body composition, and dietary intake: a longitudinal study before and after liver transplantation. *Transplantation* 2013; **96**: 579-585 [PMID: 23851933 DOI: 10.1097/TP.0b013e31829d924e]

24 **Kawakami M**, Liu M, Wada A, Otsuka T, Nishimura A. Resting Energy Expenditure in Patients with Stroke during the Subacute Phases - Relationships with Stroke Types, Location, Severity of Paresis, and Activities of Daily Living. *Cerebrovasc Dis* 2015; **39**: 170-175 [PMID: 25720382 DOI: 10.1159/000375155]

25 **Powell-Tuck J**. Nutritional interventions in critical illness. *Proc Nutr Soc* 2007; **66**: 16-24 [PMID: 17343768 DOI: 10.1017/S0029665107005253]

26 **Fredrix EW**, Soeters PB, von Meyenfeldt MF, Saris WH. Resting energy expenditure in cancer patients before and after gastrointestinal surgery. *JPEN J Parenter Enteral Nutr* 1991; **15**: 604-607 [PMID: 1766048 DOI: 10.1177/0148607191015006604]

27 **Lobo DN**, Gianotti L, Adiamah A, Barazzoni R, Deutz NEP, Dhatariya K, Greenhaff PL, Hiesmayr M, Hjort Jakobsen D, Klek S, Krznaric Z, Ljungqvist O, McMillan DC, Rollins KE, Panisic Sekeljic M, Skipworth RJE, Stanga Z, Stockley A, Stockley R, Weimann A. Perioperative nutrition: Recommendations from the ESPEN expert group. *Clin Nutr* 2020; **39**: 3211-3227 [PMID: 32362485 DOI: 10.1016/j.clnu.2020.03.038]

28 **Long CL**, Schaffel N, Geiger JW, Schiller WR, Blakemore WS. Metabolic response to injury and illness: estimation of energy and protein needs from indirect calorimetry and nitrogen balance. *JPEN J Parenter Enteral Nutr* 1979; **3**: 452-456 [PMID: 575168 DOI: 10.1177/014860717900300609]

29 **Bendavid I**, Lobo DN, Barazzoni R, Cederholm T, Coëffier M, de van der Schueren M, Fontaine E, Hiesmayr M, Laviano A, Pichard C, Singer P. The centenary of the Harris-Benedict equations: How to assess energy requirements best? *Clin Nutr* 2021; **40**: 690-701 [PMID: 33279311 DOI: 10.1016/j.clnu.2020.11.012]

30 **Tignanelli CJ**, Andrews AG, Sieloff KM, Pleva MR, Reichert HA, Wooley JA, Napolitano LM, Cherry-Bukowiec JR. Are Predictive Energy Expenditure Equations in Ventilated Surgery Patients Accurate? *J Intensive Care Med* 2019; **34**: 426-431 [PMID: 28382850 DOI: 10.1177/0885066617702077]

31 **Donadon M**, Mimmo A, Costa G, Cimino M, Viganò L, Palmisano A, Torzilli G. Measurement of Total Liver Volume Using the Energy Expenditure: A New Formula. *World J Surg* 2018; **42**: 3350-3356 [PMID: 29691622 DOI: 10.1007/s00268-018-4632-8]

32 **Fredrix EW**, Soeters PB, Wouters EF, Deerenberg IM, von Meyenfeldt MF, Saris WH. Effect of different tumor types on resting energy expenditure. *Cancer Res* 1991; **51**: 6138-6141 [PMID: 1657379]

33 **Chinda D**, Shimoyama T, Hayamizu S, Miyazawa K, Arai T, Yanagimachi M, Tsukamoto T, Mikami T, Fukuda S. Energy metabolism during the perioperative period of gastric endoscopic submucosal dissection. *J Clin Biochem Nutr* 2017; **61**: 153-157 [PMID: 28955134 DOI: 10.3164/jcbn.17-16]

34 **Chinda D**, Shimoyama T, Miyazawa K, Arai T, Hayamizu S, Yanagimachi M, Tsukamoto T, Akitaya K, Tatsuta T, Kawaguchi S, Kikuchi H, Hiraga H, Sawaya M, Sakuraba H, Mikami T, Fukuda S. Estimation of perioperative invasiveness of colorectal endoscopic submucosal dissection evaluated by energy metabolism. *J Clin Biochem Nutr* 2018; **63**: 164-167 [PMID: 30279629 DOI: 10.3164/jcbn.18-12]

35 **Inoue Y**. Estimation of energy need -Should stress factor and activity factor be considered? JSPEN 2010; 25: 573-579

36 **Suzuki K**, Sato H, Kikuchi T, Abe T, Nakaji S, Sugawara K, Totsuka M, Sato K, Yamaya K. Capacity of circulating neutrophils to produce reactive oxygen species after exhaustive exercise. *J Appl Physiol (1985)* 1996; **81**: 1213-1222 [PMID: 8889756 DOI: 10.1152/jappl.1996.81.3.1213]

37 **Hasegawa H**, Suzuki K, Nakaji S, Sugawara K. Analysis and assessment of the capacity of neutrophils to produce reactive oxygen species in a 96-well microplate format using lucigenin- and luminol-dependent chemiluminescence. *J Immunol Methods* 1997; **210**: 1-10 [PMID: 9502580 DOI: 10.1016/s0022-1759(97)00159-2]

38 **Lee S**, Takahashi I, Matsuzaka M, Yamai K, Danjo K, Kumagai T, Umeda T, Itai K, Nakaji S. The relationship between serum selenium concentration and neutrophil function in peripheral blood. *Biol Trace Elem Res* 2011; **144**: 396-406 [PMID: 21691799 DOI: 10.1007/s12011-011-9108-8]

39 **Mikami M**, Takahashi I, Matsuzaka M, Danjo K, Yamai K, Inoue R, Iwane K, Umeda T, Nakaji S. The relationship between exhaled carbon monoxide and human neutrophil function in the Japanese general population. *Luminescence* 2011; **26**: 162-166 [PMID: 21681908 DOI: 10.1002/bio.1199]

40 **Suzuki K**, Nakaji S, Yamada M, Liu Q, Kurakake S, Okamura N, Kumae T, Umeda T, Sugawara K. Impact of a competitive marathon race on systemic cytokine and neutrophil responses. *Med Sci Sports Exerc* 2003; **35**: 348-355 [PMID: 12569227 DOI: 10.1249/01.MSS.0000048861.57899.04]

41 **Miura M**, Umeda T, Nakaji S, Liu Q, Tanabe M, Kojima A, Yamamoto Y, Sugawara K. Effect of 6 mo' training on the reactive oxygen species production capacity of neutrophils and serum opsonic activity in judoists. *Luminescence* 2005; **20**: 1-7 [PMID: 15586397 DOI: 10.1002/bio.777]

42 **Chinda D**, Shimoyama T, Arai T, Sawada K, Akitaya K, Kudo S, Yasuda K, Miyazawa K, Akimoto N, Sato S, Hayamizu S, Tatsuta T, Kikuchi H, Hiraga H, Sawaya M, Sakuraba H, Mikami T, Nakaji S, Fukuda S. Usefulness of serum opsonic activity measured by chemiluminescence method to assess the invasiveness of colorectal endoscopic mucosal dissection. *Free Radic Res* 2020; **54**: 810-817 [PMID: 31615273 DOI: 10.1080/10715762.2019.1681590]

43 **Yokota K**, Nishihira T, Shineha R, Sayama J, Nitta Y, Kimura M, Mori S. Association between elevated plasma granulocyte colony-stimulating factor and the degree of surgical stress in patients undergoing gastrointestinal surgery. *Surg Today* 1995; **25**: 579-584 [PMID: 7549267 DOI: 10.1007/BF00311429]
44 **Yokota K**, Shineha R, Nishihira T, Mori S. Perioperative alterations in polymorphonuclear leukocyte function of gastrointestinal surgery. *Tohoku J Exp Med* 1993; **169**: 103-112 [PMID: 8236241 DOI: 10.1620/tjem.169.103]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com