Original paper

Benign diseases of the gastro-oesophageal junction

Łagodne choroby połączenia przełykowo-żołądkowego

Łukasz G. Nawacki[1,2], Stanisław Głuszek[1,2], Tadeusz Kuder[3]

[1]Clinical Department of General, Oncological, and Endocrinological Surgery, Regional Hospital, Kielce, Poland
Head of the Department: Prof. Stanisław Głuszek MD, PhD
[2]Department of Surgery and Surgical Nursing with Research Laboratory, Institute of Medical Sciences, Faculty of Medicine and Health Science, Jan Kochanowski University, Kielce, Poland
Head of the Department: Prof. Stanisław Głuszek MD, PhD
[3]Department of Anatomy, Institute of Medical Sciences, Faculty of Medicine and Health Science, Jan Kochanowski University, Kielce, Poland
Head of the Department: Prof. Tadeusz Kuder PhD

Medical Studies/Studia Medyczne 2016; 32 (4): 248–254
DOI: 10.5114/ms.2016.64697

Key words: hiatal hernia, gastroesophageal reflux disease, achalasia, fundoplication, cardiomyotomy.

Słowa kluczowe: przepuklina rozworu przełykowego przepony, choroba refluksowa przełyku, achalazja przełyku, fundoplikacja, kardiomiotomia.

Abstract

Introduction: Benign diseases of the gastro-oesophageal junction are among the most frequent gastroenterological diseases, and include hiatal hernia of the diaphragm, gastro-oesophageal reflux, and oesophageal achalasia. The first two entities are frequently concomitant diseases; therefore, sometimes it is difficult to differentiate from which disease dominant symptoms are seen in a patient. Due to their anatomical location the diseases of the gastro-oesophageal junction may imitate complaints on the part of other organs and systems. A patient with sharp stabbing pain in the chest would probably be diagnosed for coronary, and not reflux disease. This is related with delayed diagnosis and implementation of the proper treatment.
Aim of the research: To demonstrate our own experiences in surgical management of diseases of the gastro-oesophageal junction, the available methods, and outcomes of treatment.
Material and methods: Retrospective analysis was performed of medical records of patients hospitalised in one research centre due to diseases of the gastro-oesophageal junction. The type of disease, age, gender, treatment method, duration of surgical procedure, duration of hospitalisation, and the outcome of treatment were taken into consideration.
Results and conclusions: The outcomes of treatment were compiled in the form of a table. It was confirmed that in the case of diseases of the gastro-oesophageal junction, surgical treatment is a very important element, with a low number of complications and very good therapeutic effect.

Streszczenie

Wprowadzenie: Łagodne choroby połączenia przełykowo-żołądkowego są jednymi z najczęstszych chorób gastroenterologicznych. Zalicza się do nich przepuklinę rozworu przełykowego przepony, refluks żołądkowo-przełykowy oraz achalazję wpustu. Dwie pierwsze jednostki są schorzeniami często ze sobą współistniejącymi. W związku z tym czasami trudno jest rozróżnić, objawy której choroby przeważają u chorego. Ze względu na lokalizację anatomiczną choroby połączenia przełykowo-żołądkowego mogą imitować dolegliwości ze strony innych narządów i układów. Pacjent z piekącym bólem w klatce piersiowej najpewniej będzie diagnozowany w kierunku choroby wieńcowej, a nie choroby refluksowej. Wiąże się to z opóźnieniem rozpoznania i wdrożenia prawidłowej terapii.
Cel pracy: Pokazanie doświadczeń własnych w leczeniu chirurgicznym chorób połączenia przełykowo-żołądkowego, aktualnie dostępnych metod oraz efektów terapii.
Materiał i metody: Przeanalizowano retrospektywnie historie chorób pacjentów hospitalizowanych w jednym ośrodku badawczym z powodu chorób połączenia przełykowo-żołądkowego. Pod uwagę brano: rodzaj choroby, wiek, płeć, metodę leczenia, czas trwania zabiegu chirurgicznego, czas trwania hospitalizacji oraz wynik leczenia.
Wyniki i wnioski: Wyniki leczenia zestawiono w formie tabeli. Wykazano, że w przypadku chorób połączenia przełykowo-żołądkowego leczenie operacyjne stanowi bardzo ważne ogniwo, z niewielką liczbą powikłań i bardzo dobrym efektem terapeutycznym. Wiąże się to z rozwojem coraz to nowszych metod leczenia miniinwazyjnego (laparoskopia, SILS, chirurgia przez naturalne otwory ciała), jak również nowych metod leczenia endoskopowego.

Introduction

According to the consensus from Montreal 2006, gastro-oesophageal reflux is defined as a condition that develops when the reflux of stomach contents causes troublesome symptoms and/or complications [1]. The prevalence of this disease in Europe is 8.8–25.9%, and it has been systematically increasing since 1995 [2]. In 1972, a hypothesis was made that decreased lower oesophageal sphincter (LES) pressure is responsible for the disease [3]. Until that time, the main causes of the symptoms of the disease were considered to be weakness of the phrenoesophageal ligament and widening of the oesophageal hiatus. In this case, there occurs the translocation of the gastro-oesophageal junction in a cephalic direction and the development of so-called hiatal hernia. Both disease entities may exist independently. Nevertheless, it has been confirmed that the presence of hiatal hernia is conducive to more frequent symptoms of reflux disease. The diaphragm, together with the smooth muscles of the oesophagus and the stomach, performs the function of an anti-reflux barrier. The weakening of the function of any of these components favours the occurrence of the symptoms of the disease. The symptoms are divided into two groups: 1) those directly related with the release of the gastric contents into the oesophagus – burning pain in the chest and acidic taste in the mouth; and 2) non-typical symptoms suggesting other diseases – chronic cough, hoarseness, sore throat. Apart from the clinical examination the diagnosis is made based on endoscopy, radiological examination with contrast medium (RTG), oesophageal manometry, and pH-metry. The methods of treatment may be divided into two basic groups. The first, dominant group is pharmacotherapy related, primarily with the use of drugs decreasing the acidity of gastric juice. The second, surgical group may be divided into several methods: endoscopic, open, laparoscopic, robot-assisted, and hybrid procedures.

The subsequent disease of the gastro-oesophageal junction is oesophageal achalasia. Contrary to gastro-esophageal reflux disease (GERD) and hiatal hernia, this is a motoric disorder of the oesophagus related with an abnormal, increased lower oesophageal sphincter pressure, which impairs the normal food passage. Therefore, the initial symptoms – disorders in swallowing, vomiting, pain in the chest – may imitate GERD and delay correct diagnosis. The frequency of occurrence of the disease is estimated at 1 case per 10,000 population [4]. From the first description of the disease in 1674, many theories were made concerning its development. At present, the cause is considered an atrophy of neurons reacting to nitric oxide (NO) and vasoactive intestinal peptide (VIP) in the mucous plexuses of the lower oesophagus [5]. The diagnosis is made based on the clinical symptoms, endoscopy of the upper gastrointestinal tract, RTG examination with contrast medium, and oesophageal manometry, which is the gold standard for the diagnosis of achalasia. In therapy, pharmacological methods are applied, including injections of botulinum toxin. These methods are used infrequently and are rather reserved for patients who have not been qualified for endoscopic or surgical treatment.

Aim of the research

Demonstration of the outcomes of treatment of diseases of the gastro-oesophageal junction, and analysis of currently available methods of surgical treatment.

Material and methods

The study covered patients who received surgical treatment in the Clinic of General, Oncologic, and Endocrine Surgery, Regional Polyclinical Hospital in Kielce due to diseases of the gastro-oesophageal junction. The diagnosis was made based on a clinical examination, endoscopy of the upper gastrointestinal tract, examination using contrast medium, and, in specified cases, computed tomography of the abdominal cavity. The type of disease, age, gender, treatment method, duration of surgical procedure, duration of hospitalisation, and the outcome of treatment were evaluated.

Results

Analysis covered 33 patients, including 21 males and 12 females; mean age of males – 46.86 years; median value – 46 years; mean age of females – 56.17 years, median value – 60.5 years. Among the patients who had undergone surgical treatment, 22 surgeries of hiatal hernia with simultaneous fundoplication were performed (13 males and 9 females; mean age 49.85 and 57.22, respectively). Six patients had been previously classified for surgery due to GERD, four procedures were performed by an open method: two Dor fundoplications, and two Nissen fundoplications. The mean duration of the procedure was 142.5 min, and the duration of hospitalisation was 6.25 days. The remaining 18 surgeries were performed by laparoscopic method: 12 by Nissen, five by Dor, and one by Toupet. The mean duration of the procedure was 105 min, and the duration of hospitalisation was 6.5 days. Among all patients, in 11 – Heller's cardiomyotomy procedures were performed (8 males – mean age: 42 years, and 3 females – mean age: 53 years). Five surgeries were performed by an open method and six by laparoscopic method. The mean duration of procedure was 71 and 94.17 min, respectively, and the duration of hospitalisation was 8.2 days and 7.3 days. There occurred three complications. One intra-operative complication in a patient who had undergone surgery due to achalasia by the laparoscopic method. In this patient there occurred perforation of the oesophageal

mucosa; the perforation site was sutured using Endo Stitch with good result. The second complication was a too-tight Nissen fundoplication. The patient vomited even after liquids and required repeated surgery – one suture was cut by laparoscopic method, which resulted in the disappearance of the complaints. The last patient, operated due to achalasia, required repeated surgery during the same hospitalisation due to the absence of improvement after the first procedure. During the second surgery, a 3-cm fibrous ring of the oesophageal circular muscle layer was additionally removed under the control of a gastroscope, which resulted in remission of the complaints. At discharge from hospital, all patients consumed liquid meals in small portions, and complaints while swallowing were reduced or totally eliminated. In health check-ups performed after 6 months, in the group of patients who had undergone surgery due to hiatal hernia or GERD, 17 (77.3%) patients had no symptoms of the disease and discontinued proton pump inhibitors (PPI), while the remainder (5 patients – 22.7%) reduced the PPI dose by a half. Among the patients who had undergone surgery due to oesophageal achalasia, the health check-up after six months showed that 81.8% (9) of them had no symptoms of the disease, whereas in the remaining 2 (18.2%) patients the symptoms of the disease recurred. The detailed information about the patients and results of the study are presented in the Tables I–III.

Discussion

Diseases of the gastro-oesophageal junction are among the most frequent benign diseases of the gastrointestinal tract. In the case of GERD, in the first line of treatment, PPIs are applied in a standard dose for 8 weeks, in combination with the modification of lifestyle. If the complaints persist over this period it is recommended to double the PPI dose, change to another preparation, or add other drugs which neutralise hydrochloric acid, e.g. histamine H2 (H2RA) receptor blocker [6]. The main cause of treatment of oesophageal reflux disease is prevention of its complications, and consequently the development of Barrett's oesophagus and cancer associated with it, as well as an improvement in the quality of life of the patients. In the case of absence of effectiveness of pharmacological treatment, i.e. the occurrence of endoscopic changes resulting from GERD, clinical symptoms, side-effects of using drugs that reduce the acidity of the gastric juice, or the co-occurrence a large hiatal hernia, surgical treatment is recommended. In recent years, endoscopic methods have become increasingly more important considering the lower perioperative risk and the lack of scars on the skin. At present, several methods of endoscopic treatment are used [7]. The first method, EsophyX, consists of the reconstruction of the gastroesophageal valve. The effectiveness of this method has been confirmed in several studies, compared to pharmacotherapy, or even with Nissen fundoplication, which is considered the gold standard for treatment [8–10]. The second procedure by Stretta applies radiofrequency energy in the form of radio waves to the lower oesophageal sphincter and the gastric cardia. The mechanism of effect has not yet been fully recognised, but it probably results from the formation of a local inflammatory process in the sphincter wall, which causes its thickening, and related with it, a lower frequency of its relaxation [11]. The studies concerning this method differ. In 2014, Lipka *et al.* [12] showed the lack of effectiveness of the use of radio waves in the treatment of GERD. An earlier study by Perry *et al.* [13] demonstrated a reduction in the frequency of the symptoms of the disease in patients and an improvement of their quality of life. The subsequent method is endoscopic fundoplication. However, this method is limited to patients who do not have hiatal hernia. In the studies conducted [9, 14], the effectiveness of this method was confirmed after 6 months; however, its effects after 1 year were not fully satisfactory and normalisation of the oesophageal pH occurred only in 29% of patients. In relation to the limitation of the reliability of studies concerning the endoscopic methods of treatment of GERD, at present, this type of therapy cannot replace the standard surgical treatment. As mentioned before, the gold standard for the treatment of reflux disease is laparoscopic Nissen fundoplication [15]. Surgical procedures performed by the laparoscopic method are preferred in the majority of cases of GERD, due to the shorter time of hospitalisation, lower post-operative pain, lower risk of surgical site infection, and related with it, postoperative abdominal hernia [16]. In the presented study, a shorter duration of surgery and a shorter time of hospitalisation were obtained, compared to the open method. At the same time, a lower demand for analgesics was observed. No infection of the surgical site occurred in any of the groups. As well as Nissen fundoplication, there are other types of procedures. The Dor fundoplication procedure involves suturing the fundus of the stomach to the anterior surface of the gastro-oesophageal junction and the left crus of the diaphragm. It was confirmed that this procedure is less effective in controlling the symptoms of GERD, and consequently, the patients more often require repeated surgery, compared to the Nissen procedure [17]. The subsequent method is Toupet fundoplication, also called partial posterior fundoplication, covering 270° of the circumference of the oesophagus. Many studies have been conducted comparing the outcomes of treatment by this and the Nissen methods. In the case of the Toupet fundoplication procedure, the outcomes of treatment depend, to a great extent, on the length of the sutured wrap. With respect to controlling the symptoms of the disease, Toupet fundoplication seems to be an interesting alternative to the Nissen fundoplication procedure [6]. In each of these

Table 1. Compilation of patients surgically treated due top diseases of the gastro-oesophageal junction

No.	Gender	Age [years]	Disease	Mode of procedure	Type of surgery	Method of surgical procedure	Duration of surgery [min]	Duration of hospitalization [days]	Duration of post-operative period [days]
1	M	56	Perforation of gastric ulcer in diaphragmatic hernia	Emergency	Suturing of perforation of gastric ulcer. Debridement of diaphragmatic hernia	Class.	75	6	5
2	M	44	GERD. Hiatal hernia	Planned	Nissen fundoplication	Lap.	130	6	5
3	M	42	GERD. Hiatal hernia	Planned	Nissen fundoplication	Lap.	80	4	2
4	F	64	GERD. Hiatal hernia	Planned	Nissen fundoplication	Lap.	105	4	2
5	M	53	GERD. Hiatal hernia	Planned	Nissen fundoplication	Lap.	170	5	3
6	F	29	Hiatal hernia	Planned	Nissen fundoplication	Lap.	80	6	4
7	M	67	Hiatal hernia	Planned	Dor fundoplication	Lap.	120	6	4
8	F	64	Hiatal hernia	Planned	Nissen fundoplication	Lap.	100	4	2
9	F	59	Hiatal hernia	Planned	Nissen fundoplication	Lap.	90	10	8
10	M	60	Hiatal hernia	Planned	Nissen fundoplication	Lap.	145	6	4
11	F	62	Hiatal hernia	Planned	Nissen fundoplication	Class.	130	6	4
12	M	46	Hiatal hernia	Planned	Nissen fundoplication	Lap.	135	10	3
13	M	55	GERD. Hiatal hernia	Planned	Toupet fundoplication	Lap.	95	7	4
14	F	58	GERD. Hiatal hernia	Planned	Nissen fundoplication	Lap.	60	7	4
15	M	52	Hiatal hernia	Planned	Dor fundoplication	Class.	195	6	4
16	F	54	Hiatal hernia	Planned	Nissen fundoplication	Lap.	85	5	3
17	F	63	Hiatal hernia	Planned	Dor fundoplication	Lap.	100	5	3
18	M	23	Hiatal hernia	Planned	Nissen fundoplication	Lap.	80	4	2
19	M	27	Hiatal hernia	Planned	Dor fundoplication	Lap.	70	5	3
20	F	62	Hiatal hernia	Planned	Dor fundoplication	Lap.	135	8	4
21	M	57	Hiatal hernia	Planned	Dor fundoplication	Class.	170	7	5
22	M	66	Hiatal hernia	Planned	Dor fundoplication	Lap.	110	7	5
23	F	36	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Class.	60	8	6

Table 1. Cont.

No.	Gender	Age [years]	Disease	Mode of procedure	Type of surgery	Method of surgical procedure	Duration of surgery [min]	Duration of hospitalization [days]	Duration of post-operative period [days]
24	M	58	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Class.	95	9	7
25	F	57	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Class.	65	7	5
26	F	66	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Class.	75	7	5
27	M	44	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Lap.	80	5	3
28	M	33	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Lap.	75	5	3
29	M	41	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Lap.	70	5	3
30	M	21	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Lap.	135	9	7
31	M	32	Oesophageal achalasia	Emergency	Heller's cardiomyotomy	Lap.	85	15	4
32	M	70	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Class.	60	10	7
33	M	37	Oesophageal achalasia	Planned	Heller's cardiomyotomy	Lap.	120	5	3

M – male, F – female, Class. – classical, Lap. – laparoscopic.

procedures it is possible to perform the surgery by the LESS method (laparoendoscopic single-site surgery), in which a single incision is made in the umbilicus region. In the presented study, a similar effectiveness of treatment was observed while comparing the LESS with the 'traditional' laparoscopy [18]. The cosmetic effect is considerably better in the case of a single incision; however, the duration of the procedure is longer. In addition, fundoplication procedures may be performed robot-assisted. They are successful especially in the case of repeated surgery due to the recurrence of GERD, where they allow a better visualisation of the surgical site and a higher precision [19].

One of the latest methods of surgical treatment of GERD is the laparoscopic placement of the LINX device. This functions as a magnet, and while implanted around the lower oesophageal sphincter it causes an attraction between the opposite oesophageal walls, increasing its pressure. In a non-randomised study, the effectiveness of the method proved to be comparable to the laparoscopic Nissen procedure and, at the same time, burdened with fewer complications [20]. The subsequent new method is the implantation of a device stimulating the lower oesophageal sphincter – EndoStim [21]. The results of the study, also non-randomised, are promising – from 70% to 80% of patients in the check-up carried out after 2 years negated the taking of proton pump inhibitors.

Contrary to GERD, surgery and endoscopy play a crucial role in the treatment of achalasia. Pharmacotherapy is basically reserved only for the patients who for some reason have not been qualified for surgery. The most effective endoscopic method is dilation of the constricted area with a dilating balloon. Studies have shown that the effectiveness of treatment using this method was from 50% to 93%, according to the width of the balloon [22]. It is recommended that its dimensions are gradually increased, considering the risk of perforation of the oesophagus, which occurs even in 1.9% of cases (from 0% to 16%) [23]. The advantage of this method is the possibility of repeated dilation in the case of recurrence of symptoms. One of the latest methods of treatment of achalasia is peroral endoscopic myotomy (POEM) in which, after separation of the mucosa and submucosa, the cutting of the circular muscle layer is performed. During 6 months of observation, the outcomes of treatment were comparable to the classical myotomy; however, the patients complained of the symptoms of reflux disease [24]. The most frequently performed procedure in the case of achalasia is laparoscopic cardiomyotomy via the transabdominal or transthoracic approach. Its effectiveness ranges between the performed studies and is approximately 85% (from 48% to 100%) [22]. Similarly to the balloon dilating, its effects decrease with time. An additional undesirable symptom of cardiomyotomy is the possibility of occurrence of GERD – in

Table 2. Analysis of patients treated due to GERD

Gender	No. of patients	Mean age of patients [years]	Median age [years]	Type and no. of surgeries	Mean duration of laparoscopic procedure [min]	Mean duration of classical procedure [min]	Mean duration of hospitalisation after laparoscopic procedure [days]	Mean duration of hospitalisation after classical procedure [min]
Females	9	57.22	62	Nissen: 7 (1 class.) Dor: 2	105	142.5	6.05	6.25
Males	13	49.85	53	Nissen: 6 (2 class.) Dor: 5 Toupet: 1 Other: 1 (class.)				

Table 3. Analysis of patients treated due to oesophageal achalasia

Gender	No. of patients	Mean age of patients [years]	Median age [years]	Type and no. of surgeries	Mean duration of laparoscopic procedure [min]	Mean duration of classical procedure [min]	Mean duration of hospitalisation after laparoscopic procedure [days]	Mean duration of hospitalisation after classical procedure [min]
Females	3	53	57	Heller: 3 (class.)	71	94.17	7.3	8.2
Males	8	42.3	39	Heller: Class.: 2 Lap.: 6				

approximately 30% of cases [25]. Therefore, according to the American guidelines, an anti-reflux procedure – fundoplication – should be simultaneously performed during the surgery [26]. Laparoscopic surgical procedures bring about all the benefits resulting from the method. The effectiveness of treatment is nearly identical to that of open surgeries. In the presented study, in all patients the symptoms of the disease resolved. The duration of hospitalisation was significantly shorter in the case of minimally invasive treatment. This procedure may also be performed by the LESS technique, with effectiveness similar to that of a classical laparoscopy [27]. In some cases, in patients who do not respond to either endoscopic or surgical treatment, resection of a part of the oesophagus may be necessary. Improvement of the state of health and the resolution of symptoms is observed in more than 80% of patients. Nevertheless, this procedure is related with a significantly higher mortality [22].

Conclusions

Minimally invasive surgery is an effective method of treatment of GERD and oesophageal achalasia. The risk of complications is very low, and recurrences are conditioned by many factors responsible for the primary aetiology of the disease.

Conflict of interest

The authors declare no conflict of interest.

References

1. Vakil N, van Zanten SV, Kahrilas P, Dent J, Jones R; Global Consensus Group. The Montreal definition and classification of gastroesophageal reflux disease: a global evidence- based consensus. Am J Gastroenterol 2006; 101: 1900-20.
2. Frye J, Peura D. Managing gastroesophageal disease – comparative efficacy and outcomes of dexlansoprazole MR. Ther Clin Risk Manag 2015; 11: 1649-56.
3. Cohen S, Harris LD. The lower esophageal sphincter. Gastroenterology 1972; 63: 1066-73.
4. Vaezi MF, Felix VN, Penagini R, Mauro A, de Moura EG, Pu LZ, Martínek J, Rieder E. Achalasia: from diagnosis to management. Ann N Y Acad Sci 2016; 1381: 34-44.
5. Singaram C, Sengupta A, Sweet MA, Sugarbaker DJ, Goyal RK. Nitrinergic and peptideric innervation of the human oesophagus. Gut 1994; 35: 1690-6.

6. Iwakiri K, Kinoshita Y, Habu Y, Oshima T, Manabe N, Fujiwara Y, Nagahara A, Kawamura O, Iwakiri R, Ozawa S, Ashida K, Ohara S, Kashiwagi H, Adachi K, Higuchi K, Miwa H, Fujimoto K, Kusano M, Hoshihara Y, Kawano T, Haruma K, Hongo M, Sugano K, Watanabe M, Shimosegawa T. Evidence based clinical practice guidelines for gastroesophageal reflux disease 2015. J Gastroenterol 2016; 51: 751-67.
7. Hopkins J, Switzer NJ, Karmali S. Update on novel endoscopic therapies to treat gastroesophageal reflux disease: a review. World J Gastrointest Endosc 2015; 7: 1039-44.
8. Svoboda P, Kantorová I, Kozumplík L, Scheer P, Radvan M, Radvanová J, Krass V, Horálek F. Our experience with transoral incisionless plication of gastroesophageal reflux disease: NOTES procedure. Hepatogastroenterology 2011; 58: 1208-13.
9. Hunter JG, Kahrilas PJ, Bell RC, Wilson EB, Trad KS, Dolan JP, Perry KA, Oelschlager BK, Soper NJ, Snyder BE, Burch MA, Melvin WS, Reavis KM, Turgeon DG, Hungness ES, Diggs BS. Efficacy of transoral fundoplication vs omeprazole for treatment of regurgitation in a randomized controlled trial. Gastroenterology 2015; 148: 324-33.
10. Trad KS, Barnes WE, Simoni G, Shughoury AB, Mavrelis PG, Raza M, Heise JA, Turgeon DG, Fox MA. Transoral incisionless fundoplication effective in eliminating GERD symptoms in partial responders to proton pump inhibitor therapy AT 6 months: the TEMPO Randomized Control Trial. Surg Innov 2015; 22: 26-40.
11. Kahrilas PJ. Radiofrequency therapy of the lower esophageal sphincter for treatment of GERD. Gastrointest Endosc 2003; 57: 723-31.
12. Lipka S, Kumar A, Richter JE. No evidence for efficacy of radiofrequency ablation for treatment of gastroesophageal reflux disease: a systematic review and meta-analysis. Clin Gastroenterol Hepatol 2015; 13: 1058-67.
13. Perry KA, Banerjee A, Melvin WS. Radiofrequency energy delivery to the lower esophageal sphincter reduces esophageal acid exposure and improves GERD symptoms: a systematic review and meta-analysis. Surg Laparosc Endosc Percutan Tech 2012; 22: 283-8.
14. Witteman BP, Conchillo JM, Rinsma NF, Betzel B, Peeters A, Koek GH, Stassen LP, Bouvy ND. Randomized controlled transoral incisionless fundoplication vs. proton pump inhibitors for treatment of gastroesophageal reflux disease. Am J Gatroenterol 2015; 110: 531-42.
15. Pandolfino JE, Krishan K. Do endoscopic antireflux procedures fit in the current treatment paradigm of gastroesophageal reflux disease? Clin Gastroenterol Hepatol 2014; 12: 544-54.
16. Moore M, Afaneh C, Benhuri D, Antonacci C, Abelson J, Zarnegar R. Gastroesophageal reflux disease: a review of surgical decision making. World J Gastrointest Surg 2016; 8: 77-83.
17. Cai W, Watson DI, Lally CJ, Devitt PG, Game PA, Jamieson GG. Ten-year clinical outcome of prospective randomized clinical trial of laparoscopic Nissen versus anterior 180 (degrees) partial fundoplication. Br J Surg 2008; 95: 1501-5.
18. Ross S, Roddenbery A, Luberice K, Paul H, Farrior T, Vice M, Patel K, Rosemurgy A. Laparoendoscopic single site (LESS) vs. conventional laparoscopic fundoplication for GERD: is there a difference? Surg Endosc 2013; 27: 538-47.
19. Tolboom R, Draaisma W, Broeders I. Evaluation of conventional laparoscopic versus robot-assisted laparoscopic redo hiatal hernia and antireflux surgery: a cohort study. J Robotic Surg 2016; 10: 33-9.
20. Ganz RA, Gostout CJ, Grudem J, Swanson W, Berg T, DeMeester TR. Use of a magnetic sphincter for the treatment of GERD: a feasibility study. Gastrointest Endosc 2008; 67: 287-94.
21. Rodríguez L, Rodriguez P, Gómez B, Ayala JC, Oxenberg D, Perez-Castilla A, Netto MG, Soffer E, Boscardin WJ, Crowell MD. Two-year results of interminnent electric al stimulation of the lower esophageal sphincter treatment of gastroesophageal reflux disease. Surgery 2015; 157: 556-67.
22. Ates F, Vaezi M. The pathogenesis and management of achalasia: current status and future directions. Gut Liver 2015; 9: 449-63.
23. Eckardt VF, Kanzler G, Westermeier T. Complications and their impast after pneumatic dilation for achalasia: prospective long-term follow-up study. Gastrointest Endosc 1997; 45: 349-53.
24. Bhayani NH, Kurian AA, Dunst CM, Sharata AM, Rieder E, Swanstrom LL. A comparative study on comprehensive, objective outcomes of laparoscopic Heller miotomy with per-oral endoscopic miotomy (POEM) for achalasia. Ann Surg 2014; 259: 1098-103.
25. Campos GM, Vittinghoff E, Rabl C, Takata M, Gadenstätter M, Lin F, Ciovica R. Endoscopic and surgical treatments for achalasia: a systematic review and meta-analysis. Ann Surg 2009; 249: 45-57.
26. Stefanidis D, Richardson W, Farrell TM, Kohn GP, Augenstein V, Fanelli RD; Society of American Gastrointestinal and Endoscopic Surgeons. SAGES guidelines for the surgical treatment of esophageal achalasia. Surg Endosc 2012; 26: 296-311.
27. Barry L, Ross S, Dahal S, Morton C, Okpaleke C, Rosas M, Rosemurgy AS. Laparoendoscopic single-site Heller myotomy with anterior fundoplication for achalasia. Surg Endosc 2011; 25: 1766-74.

Address for correspondence:

Łukasz G. Nawacki MD
Clinical Department of General, Oncological,
and Endocrinological Surgery
Regional Hospital
ul. Grunwaldzka 45, 25-736 Kielce, Poland
Phone: +48 606 994 460
E-mail: lukasznawacki@gmail.com