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CLINICAL RESEARCH

Influence of age on outcome of total laparoscopic fundoplication for gastroesophageal reflux disease

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Abstract

AIM: To demonstrate that age does not influence the choice of treatment for gastroesophageal reflux disease (GERD). We hypothesized that the outcome of total fundoplication in patients > 65 years is similar to that of patients aged ⩽ 65 years.

METHODS: Four hundred and twenty consecutive patients underwent total laparoscopic fundoplication for GERD. Three hundred and fifty-five patients were younger than 65 years (group Y), and 65 patients were 65 years or older (group E). The following elements were considered: presence, duration, and severity of GERD symptoms; presence of a hiatal hernia; manometric evaluation, 24 h pH-monitoring data, duration of operation; incidence of complications; and length of hospital stay.

RESULTS: Elderly patients more often had atypical symptoms of GERD and at manometric evaluation had a higher rate of impaired esophageal peristalsis in comparison with younger patients. A mild intensity of heartburn often leads physicians to underestimate the severity of erosive esophagitis. The duration of the operation was similar between the two groups. The incidence of intraoperative and postoperative complications was low and the difference was not statistically significant between the two groups. An excellent outcome was observed in 92.9% young patients and 91.9% elderly patients.

CONCLUSION: Laparoscopic antireflux surgery is a safe and effective treatment for GERD even in elderly patients, warranting low morbidity and mortality rates and a significant improvement of symptoms comparable to younger patients.

Key words: Gastroesophageal reflux disease; Esophagitis; Impaired peristalsis; Hiatal hernia; Laparoscopic total fundoplication

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INTRODUCTION

The population of elderly is rapidly growing globally, e.g. in the USA nearly 20 million of people will be more than 85 years old in the next fifty years[1]. Digestive diseases are common causes of morbidity and mortality in the elderly[2]. Among them gastroesophageal reflux disease (GERD) is usually more severe than in younger patients, which is frequently under-diagnosed and less treated[2]. This results in an increase of esophageal mucosal injuries and subsequent complications. Therefore, a more aggressive treatment has been advocated in these patients[3]. However, a higher morbidity and mortality of open surgery in the elderly, limited the number of these patients referred for surgical treatment. Moreover, their shorter life expectancy made surgery to be deemed a cost-ineffective strategy.

The advent of laparoscopic fundoplication has greatly reduced the morbidity of antireflux surgery and by now, it should be considered the surgical treatment of choice for GERD[4]. The aim of the current study is to review the outcome of young and elderly patients undergoing laparoscopic antireflux surgery for the treatment of GERD.

MATERIALS AND METHODS

From September 1992 to December 2005, 420 consecutive patients, 171 male and 249 female, mean age 42.8 years (range 12-80) with GERD underwent laparoscopic Nissen-Rossetti fundoplication. The preoperative and postoperative data were prospectively collected. Demographic data were obtained at the time of first visit. Sixty-five patients older than 65 years of age were defined as the elderly group (EG) whereas the remaining 355 younger than 65

years of age were defined as the young group (YG). Ethics board approval for collecting and using these data was obtained.

Preoperative evaluation

Preoperatively all patients underwent Upper Gastrointestinal Endoscopy (UE), X-ray of barium swallow, esophageal manometry and 24-h pH monitoring. They were off peptic medications for thirty days. The medical evaluation included a structured questionnaire based on modified DeMeester symptom scoring system (Table 1). Measurement of hiatal hernia size was performed at the end of endoscopic examination after deflation of the stomach or by X-ray of barium swallow with video-fluoroscopy. The hernia size was measured as the distance between the centre of the diaphragmatic hiatus and the superior aspect of gastric folds. A hiatal hernia was deemed to be present if either gastric folds or a hernia pouch was present above the diaphragm between swallows. Esophagitis severity was assessed by means of Savary-Miller grading system. The location of Barrett's esophagus was noted; and the esophageal strictures, paraesophageal hernias and reinterventions were excluded from the study. Stationary esophageal manometry was carried out using 8-channel perfusion catheters, 4 disposed radially and oriented at 90° to each other and 4 positioned longitudinally at intervals of 5 cm. The catheter was perfused with distilled water using a low-compliance capillary pump at a constant infusion rate of 0.8 mL/min at 1.2 kg/cm^2. A system of pressure transducers transmitted data to an acquisition device (ACQ1^{TM}-Menfis bioMedica-Bologna, Italy) and from there to a personal computer. A specific software package (Dyno 2000^{TM}-Menfis bioMedica-Bologna, Italy) was used for data acquisition and processing. The following variables were assessed: (1) pressure of the lower esophageal sphincter; (2) relaxation of the lower esophageal sphincter (LES) in response to swallowing; (3) amplitude and propagation of peristalsis (esophageal peristalsis was considered impaired when < 30 mmHg). The LES was studied by both the stationary and the rapid pull-through methods. Esophagogastric pH monitoring was carried out using two glass probes which were connected to a portable, solid-state recorder (Digitrapper Proxima^{TM}-Synetics Medical, Sweden): the electrodes were placed, respectively, 5 cm above the proximal margin and 5 cm below the distal margin of the LES, identified by means of stationary manometry. For statistical analysis, results were expressed as a mean value ± SD; correlations among the various parameters were analysed using Fischer's exact test. The Wilcoxon signed rank test was used to compare the preoperative and postoperative modified DeMeester symptom score. American Society of Anaesthesiologists (ASA) grade was recorded at the time of surgery.

Postoperative evaluation

On an outpatient basis, the patients came to our department each six months for the first postoperative year and, after, each year and were invited to fulfil a standardized questionnaire dealing with presence of typical or atypical symptoms and based on the modified DeMeester score (Table 1). Satisfaction of the procedure and the will of undergoing the same operation after knowing its effects were defined as excellent outcome

Instrumental follow-up after surgery included: X-ray of barium swallow (performed at 1 year after surgery), esophageal manometry (performed at 6 mo, 1 year, and 2 years after surgery) and 24 h pH monitoring (performed at 1 year after surgery).

Statistical analysis was carried out using SPSS for Windows (version 12.0, SPSS Inc. Chicago, IL). Results were expressed as mean ± SD unless otherwise indicated. Student's *t* test, the Chi-square test, the Fischer's exact test and the Wilcoxon signed rank test were used as appropriate. *P* value < 0.05 was considered statistically significant.

Table 1 Modified DeMeester scoring system

Symptoms	Score	Description
Dysphagia	0	None
	1	Occasional transient episodes
	2	Require liquids to clear
	3	Impaction requiring medical attention
Heartburn	0	None
	1	Occasional brief episodes
	2	Frequent episodes requiring medical treatment
	3	Interference with daily activities
Regurgitation	0	None
	1	Occasional episodes
	2	Predictable by posture
	3	Interference with daily activities

Table 2 Preoperative evaluation: data and ASA score in EG and YG

Demographics	EG (> 65 yr)	YG (< 65 yr)	*P*
Age (mean yr ± SD)	72.6 ± 2.1	48.2 ± 3.2	< 0.05
Male:Female	1:1.5	1:1.7	NS
ASA score	2.2 ± 0.43	1.82 ± 0.51	< 0.05
Weight (mean ± SD)	64.4 ± 5.1	65.3 ± 6.4	NS

Table 3 Incidence of pre-operative symptoms in EG and YG

Symptoms	EG (%)	YG (%)	*P*
Heartburn	44/65 (67.7)	298/355 (83.9)	< 0.05
Acid regurgitation	39/65 (60.0)	277/355 (78.0)	< 0.05
Solid food dysphagia	22/65 (33.8)	27/355 (7.6)	< 0.05
Chest pain	18/65 (27.7)	51/355 (14.4)	< 0.05
Respiratory complication (chronic cough, sleep apnoea, asthma, laryngitis)	27/65 (41.5)	19/355 (5.4)	< 0.05

RESULTS

Preoperative data

Demographics data and ASA score of the two groups are listed in Table 2. In the YG, the mean duration of preoperative symptoms was 4.6 ± 2.3 years (range 1-11) whereas in the EG it was 8.3 ± 2.5 years (range 5-22). Tables 3 and 4 depict the incidence and severity of typical and atypical

Table 4 Severity of preoperative symptoms in EG and YG (mean ± SD)

Symptoms	EG	YG	*P*
Heartburn	1.7 ± 0.87	2.7 ± 0.74	< 0.05
Acid regurgitation	1.5 ± 0.96	2.3 ± 0.89	< 0.05
Solid food dysphagia	1.6 ± 0.76	0.5 ± 0.2	< 0.05
Chest pain	1.6 ± 0.82	1.5 ± 0.87	> 0.05
Respiratory complication (chronic cough, sleep apnoea, asthma, laryngitis)	1.8 ± 1.04	1.0 ± 0.45	< 0.05

Table 5 Preoperative manometric evaluation in EG and YG

Manometry	EG	YG	*P*
LES pressure (mmHg)	11.2 ± 1.5	11.0 ± 1.2	> 0.05
Impaired esophageal peristalsis (< 30 mmHg) N° of patients	43/65 (66.2%)	114/355 (32.1%)	< 0.05

Table 6 Preoperative evaluation: incidence, size of HH and pH metric data in NERD, ERD and Barrett patients in EG and YG

	EG NERD	YG NERD	*P*	EG ERD	YG ERD	*P*	EG Barrett	YG Barrett	*P*
Patients *n* (%)	15/65 (23.1)	220/355 (62)	< 0.05	45/65 (69.2)	125/355 (35.2)	< 0.05	5/65 (7.7)	10/355 (2.8)	< 0.05
Hiatal Hernia *n* (%)	13/15 (86.7)	148/220 (67.3)	< 0.05	39/45 (86.7)	97/125 (77.6)	< 0.05	4/5 (80)	8/10 (80)	-
Hiatal Hernia size (cm)	1.2 ± 0.18	0.3 ± 0.1	< 0.05	4.1 ± 1.9	2.3 ± 0.2	< 0.05			
De Meester score	13.1 ± 1.2	12.4 ± 1.2	> 0.05	17.5 ± 1.4	14.3 ± 1.2	> 0.05	18.2 ± 1.3	16.2 ± 1.4	> 0.05
(%) time pH < 4 (total)	11 ± 3	6 ± 2	< 0.05	26 ± 3	11 ± 5	< 0.05	27 ± 6	27 ± 5	> 0.05
(%) time pH < 4 (supine)	12 ± 4	7 ± 2	< 0.05	28 ± 4	13 ± 4	< 0.05	29 ± 5	30 ± 8	> 0.05
(%) time pH < 4 (upright)	9 ± 4	5 ± 2	< 0.05	15 ± 5	5 ± 3	< 0.05	25 ± 2	22 ± 7	> 0.05

symptoms in both groups. At manometric evaluation, no statistically significant differences in the mean LES pressure were found when the two groups were compared (*P* = NS) but the EG had a higher rate of impaired esophageal peristalsis (defined as peristaltic waves with a pressure value lower than 30 mmHg) in comparison with their younger counterparts (*P* < 0.05) (Table 5). Incidence of Hiatal Hernia (HH) was 89.2% (58/65) in elderly patients and 71.3% (253/355) in young patients (*P* < 0.05).

Table 6 shows the prevalence of HH and esophagitis and pH metric values either in Non-erosive reflux disease (NERD) and in Erosive reflux disease (ERD) patients. In the EG, 45/65 (69.2%) patients presented with esophagitis (ERD group): 11 of 45 (24.4%) had a grade I esophagitis while 34 out of 45 (75.6%) had a grade Ⅱ-Ⅲ esophagitis. In the YG, 125/355 (35.2%) patients presented with esophagitis (ERD group): 76 out of 125 (60.8 %) had a grade I esophagitis while 49 of 125 (39.2%) had a grade Ⅱ-Ⅲ esophagitis.

Therefore, in the EG, a significant higher grade of esophagitis has been found along with a higher incidence of Barrett esophagus (Table 6).

A pathologic DeMeester score was found at pH-monitoring in all patients of both subgroups: in the YG, it was 12.4 ± 1.2 and 14.3 ± 1.2, whereas in the EG it was 13.1 ± 11.2 and 17.5 ± 1.4 respectively for NERD and ERD subgroups. The mean percentage of total time < 4 at 24-h pH monitoring in NERD and ERD subgroups, is shown in Table 6.

Perioperative results

All the interventions were completed *via* laparoscopic approach. Mean operative time was 45 ± 14 min in YG and 61 ± 15 min in EG. No mortality was observed in both groups. A major complication occurred in 4/420 patients (1.0%), all among the YG. Mean postoperative hospital stay was 2.4 ± 0.9 d in YG (range 1-5) and 3.8 ± 1.0 d in EG (range 1-7) (*P* < 0.05). Normal activity resumed in 8.3 ± 3.4 d in YG and 12.5 ± 9.0 d in EG (*P* < 0.05) (Table 7).

Table 7 Perioperative results in EG and YG

Intraoperative results	EG	YG	*P*
Operative time (m)	61 ± 15	45 ± 15	< 0.05
Operative blood loss (mL)	50 (0-120)	30 (0-100)	< 0.05
Major complications	0	4/355 (1.1%)[1]	-
Mortality	0	0	-
Postoperative recovery			
Post operative hospital stay (d)	3.8 ± 1.0	2.4 ± 0.9	< 0.05
Resumption of normal activity (d)	12.5 ± 9.0	8.3 ± 3.4	< 0.05

[1]1/335 intraoperative mucosal tear, 3/335 postoperative bleeding (1 splenectomy).

Postoperative results

We followed up clinically 408 (97.1%) of 420 patients, 62 (95.3%) patients in the EG and 338 (95.2%) patients in YG. Two patients in the EG died four years after surgery for no surgery correlated event. In the YG, the mean follow-up was 83.2 ± 7 mo (range 6-141) whereas in EG it was 60 ± 8 mo (range 6-95).

An excellent outcome was observed in 314/338 (92.9%) younger patients and in 57/62 (91.9%) elderly patients (*P* > 0.05). Both groups showed significant improvement

Table 8 Postoperative symptoms score in EG and YG (mean symptom score ± SD)

Symptoms	EG		*P*	YG		*P*
	Preop.	Postop.		Preop.	Postop.	
Heartburn	1.7 ± 0.87	0.2 ± 0.12	< 0.05	2.7 ± 0.74	0.3 ± 0.11	< 0.05
Acid regurgitation	1.5 ± 0.96	0.3 ± 0.13	< 0.05	2.3 ± 0.89	0.2 ± 0.12	< 0.05
Solid food dysphagia	1.6 ± 0.76	0.4 ± 0.12	< 0.05	0.5 ± 0.2	0.2 ± 0.15	< 0.05
Chest pain	1.6 ± 0.82	0.3 ± 0.21	< 0.05	1.5 ± 0.87	0.2 ± 0.13	< 0.05
Respiratory complication (chronic cough, sleep apnoea, asthma, laryngitis)	1.8 ± 1.04	0.3 ± 0.11	< 0.05	1.0 ± 0.45	0.2 ± 0.12	< 0.05

Preop: preoperative; Postop: postoperative.

Table 9 Postoperative side effects in EG and YG

	EG	YG	*P*
Postoperative side effects: number patients (%)			
Dysphagia	2/62 (3.2%)[1]	11/338 (3.3%)[2]	> 0.05
Heartburn	2/62 (3.2%)[3]	12/338 (3.6%)[4]	> 0.05
Hyperflautolence	1/62 (1.6%)	6/338 (1.8%)	> 0.05
Early satiety	2/62 (3.2%)	9/338 (2.7%)	> 0.05
Bloating	1/62 (1.6%)	3/338 (0.9%)	> 0.05
Chest pain	0	2/338 (0.6%)	> 0.05

[1]2 dilation; [2]5 dilation, 6 laparoscopic re-fundoplication; [3]2 reassumed peptic medications; [4]8 reassumed peptic medications, 4 laparoscopic re-fundoplication.

Table 10 Postoperative manometric evaluation at 24 mo after surgery in EG and YG

Manometry	EG (36 Pts)		*P*	YG (230 Pts)		*P*
	Preop.	Postop.		Preop.	Postop.	
N-HPZ pressure (mmHg)	11.2 ± 1.5	28.2 ± 1.5	< 0.05	11.0 ± 1.2	28.1 ± 1.2	< 0.05
Increase of mean peristalsis waves patients *n* (%)		28/36 (77.8%)			100/230 (43.5%)	

Preop: preoperative; Postop: postoperative.

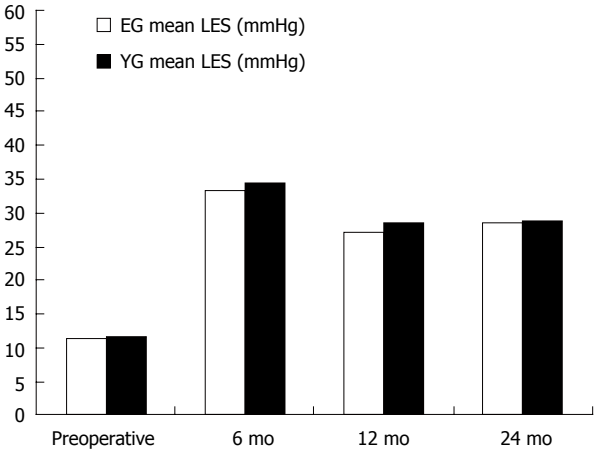

Figure 1 Modification in LES (mean in mmHg) in EG and YG.

in clinical symptom score (Table 8). At 6 mo, persisting postoperative dysphagia (DeMeester score 2-3) leading to > 15% of weight loss was observed in 11 (3.3%) of 338 patients in YG, 2 patients in the group with preoperative impaired peristalsis and 9 in the group with normal esophageal motility (Table 9). In EG, persisting postoperative dysphagia was relieved in 2 (3.2%) of 62 patients, both in group with normal preoperative esophageal peristalsis (Table 9).

No statistically significant difference was observed between patients with normal and impaired peristalsis. Five patients in YG and both 2 patients in EG were treated with endoscopic dilatation, whereas 6 patients in YG underwent a laparoscopic redo-funduplication with partial resolution of dysphagia. Recurrent heartburn was observed and confirmed with 24 h pH monitoring follow-up in 14/408 patients (3.4%), which was due to a disrupted wrap, an herniated wrap, and a slipped Nissen detected at X-ray barium in 7, 4, and 3 cases, respectively.

Ten patients reassumed their peptic medications; the remaining 4 patients, all in YG, underwent redofunduplication with partial resolution of symptoms. Respiratory symptoms showed a significant improvement in both groups (Table 9). Other data regarding hyper-flatulence, early satiety and bloating are depicted in Table 9.

Esophageal manometric follow-up (performed at 6, 12, and 24 mo after surgery) was made in 331 (81.1%) of 408 patients at 6 mo (48/62, 77.4% in EG and 283/338, 83.7% in YG), 275/408 (67.4%) at 12 mo (38/62, 61.3% in EG and 237/338, 70.1% in YG), and 266/408 (65.2%) at 24 mo (36/62, 58.1% in EG and 230/338, 68.0% in YG). Stationary esophageal manometry showed a significant improvement in the mean new high pressure zone (N-HPZ) value in comparison with preoperative values in the two groups ($P < 0.05$) (Table 10 and Figure 1); Manometric evaluation at 24 mo after surgery showed an increase of mean peristalsis waves in 28/36 (77.8%) patients of the EG and 100/230 (43.5%) patients of the YG.

Twenty-four hour pH monitoring at 1 year after surgery was performed in 205/408 (50.2%) patients. There was a significant postoperative decrease in DeMeester score and percentage of time pH < 4 during 24 h (Table 11).

DISCUSSION

Gastroesophageal reflux disease (GERD) is a common disorder in the western population; periodically symptoms

Table 11 De Meester score and percentage of reflux time during 24 h in EG and YG, preoperative and 1 yr after surgery

	Preoperative	1 yr after surgery
DeMeester score		
EG	15.1 ± 1.1	1.2 ± 0.7
YG	13.4 ± 1.5	1.1 ± 0.2
(%) time pH < 4		
EG	9.1 ± 0.6	1.4 ± 0.3
YG	8.2 ± 0.7	0.9 ± 0.8

occur in approximately 20% of adults in USA[5]. Its cost has been estimated to be $24.1 billion annually[2].

By 2020 more than 16% of population in USA are expected to be more than 65 years old while nearly 20 million ought to be more than 85 years old[6]. In the elderly, the prevalence of GERD is nearly the same among the general population, but complicated GERD appears to be more common than in young people[6].

Several authors have reported a higher incidence of esophagitis as well as Barrett esophagus in older patients[7-11]. Collen[7] found that esophagitis and Barrett esophagus were almost twice in patients aged 60 years than in young people (81% *vs* 47%, $P < 0.002$). Zhu[8] observed that the percentage of time with pH < 4 was 32.5% in older patients with GERD *vs* 12.9% in younger ones ($P < 0.05$). Furthermore, among elderly patients with esophagitis, nearly 21% had grade Ⅲ-Ⅳ disease compared with only 3.4% of younger patients ($P = 0.002$). Cameron[9] demonstrated that the prevalence of Barrett's esophagus increased with age to reach a plateau by the seventh decade. Fass[11] reported that the mean incidence rate of erosive esophagitis was 74% in the elderly and 64% in the younger patients and the frequency of symptoms was lower in the elderly group. David[12] demonstrated that the prevalence of severe esophagitis increased with age: only 12% in GERD patients < 21 years old in comparison with 37% in patients > 70 years old had severe esophagitis.

Also in our study, the elderly group (EG) had a higher rate of erosive esophagitis (69.2% *vs* 35.2.%) and a lower rate of Grade I esophagitis (22.2% *vs* 60.8%). Moreover, incidence of Barrett's esophagus as well as mean percentage of total time < 4 at pH-monitoring were significantly higher in the EG (Table 7). The frequency of reflux episodes has been reported to be similar either in the elderly or in young people whereas the duration of individual reflux episodes seems to be longer in the elderly[13]. However, it is not clear which factors lead to a more severe GERD in the elderly.

The etiopathogenesis of GERD seems to be multifactorial. The alteration may include a defective antireflux barrier, abnormal esophageal-clearance, altered esophageal mucosal resistance, and delayed gastric emptying[14].

Hiatal hernia (HH) as a structural defect of the antireflux barrier is a determining factor of GERD, by impairing both the diaphragmatic component and the clearance of acid refluxate from the distal esophagus[15]. HH has been identified in 60% of patients > 60 years old[16]. Furthermore, several studies found a higher frequency of esophagitis in patients with HH compared with patients without HH, and the severity was proportional to the size of HH. In our study, we noted a significant higher rate of HH in the EG (Table 6). Previous studies excluded any adverse effect of aging on the lower esophageal sphincter (LES) of healthy subjects[17,18]. Similarly, we did not find any significant difference in LES pressure between the EG and the YG. However, an impaired esophageal peristalsis (waves pressure < 30 mmHg) has been found in 66.7% of the EG and 33.4% of the YG (Table 5). It is not clear whether impaired peristalsis is a cause of or affects a more severe GERD, since we noted an increased amplitude of peristaltic waves both in the EG and in the YG at the postoperative manometric follow-up evaluation (Figure 1).

Changes in motility seen in older patients is related to long- term esophageal acid exposure rather than to effects of aging on esophageal smooth muscle and on collagen production that is increased in chronic inflammation[18,19]. In our study, the mean duration of preoperative symptoms was significantly longer in the EG. Probably a vicious circle begins in these subjects between cardia incontinence, increasing reflux and impaired peristalsis determining a reduction of esophageal clearing[20]. The realization of antireflux procedure seems to break this circle. Some authors described the increased amplitude of peristalsis in patients undergoing total fundoplication[21,22].

Besides, Sonnemberg showed an age dependent fall in salivary bicarbonate production while physiologic levels of gastric acid secretion remained stable in advanced age. These factors may increase esophageal acid exposure because of delayed acid clearance[23]. We found elderly patients having less frequency and severity of symptoms like heartburn and acid regurgitation than younger patients[24] (Tables 3 and 4). Raiha[24] hypothesized that typical symptoms should not be considered as expression of acid reflux in older patients. However, it is not clear which factors reduce frequency and severity of these symptoms although these patients have a higher rate of acid exposure and develop a more severe esophagitis.

Several studies have shown that altered esophageal pain perception to acid in the elderly is the result of an ageing process that may be responsible for an increased severity of GERD[11]. On the other hand, frequency and severity of atypical symptoms have been reported to be higher in elderly people with GERD[24]. Also in our study, we found a statistically significant higher rate of atypical symptoms such as dysphagia for solids, chest pain and respiratory symptoms in the EG (Tables 3 and 4).

Therefore, a mild intensity of heartburn often leads physicians to underestimate the severity of erosive esophagitis and its complications.

Surgical correction of GERD has been shown to be a cost-effective treatment by reducing long-term complications such as Barrett esophagus and stricture and by eliminating the need of a life-long medical therapy especially for young patients. However, a high morbidity and mortality rate of open surgery performed in the elderly, limited the number of these patients referred to surgical units[25]. Since a laparoscopic Nissen fundoplication

has been reported for the first time, a growing number of antireflux procedures have been performed in the USA[26]. Several studies showed laparoscopic surgery to be a safe and effective treatment for GERD being able to improve quality of life and warranting an early return to daily activities[27].

In elderly population with GERD, laparoscopic surgery has proven to be effective with low morbidity and mortality rates. Richter[2] observed that Laparoscopic Nissen Fundoplication did not increase the mortality, morbility and hospital stay in the elderly patients compared to younger surgical patients. Kalmoz[28] showed that age should not be considered a contraindication to laparoscopic surgical treatment of GERD as 97% of elderly patients would choose surgical treatment again if necessary. Bammer[29] reported that laparoscopic surgery is a good option for the treatment of severe GERD in octo- and nonagenarians, with an excellent follow-up in 93% of elderly patients. Except for preoperative disease severity, we did not find any significant difference in perioperative and postoperative results as well as in subjective and objective outcome between the two groups. The only observed differences in the operative time and blood loss seem to be related to the high ASA scores and the higher incidence and size of hiatal hernia in the EG.

Statistically significant improvement in heartburn, acid regurgitation, chest pain and respiratory complications of GERD was observed in both EG and YG (Table 9). An excellent outcome was observed in 314/338 (92.9%) younger patients and in 57/62 (91.9%) elderly patients.

A poor outcome was observed in 27 patients, 23/338 (7.1%) in YG and 4/62 (6.5%) in EG; persisting dysphagia occurred in 11/338 (3.3%) in YG and 2/62 (3.2%) in EG; and 12/338 (3.6%) in YG and 2/62 (3.2%) in EG had recurrent of heartburn. Differences between the two groups were not statistically significant also regarding the incidence of other side effects (flatulence, early satiety, etc) (Table 10). Outcome was not dependent on the presence of disordered esophageal motility.

There have been debates in literature regarding the realization of partial fundoplication in patients with defective esophageal peristalsis, and it seemed reasonable therefore, to choose this kind of wrap in elderly patients. Many authors supported the realization of a partial fundoplication in patients with impaired esophageal peristalsis to lower the incidence of persistent postoperative dysphagia[30-32]; moreover, partial wrap was considered as effective as total wrap to control gastroesophageal reflux, and short-term follow-up seemed to validate the choice of partial fundoplication[33,34]. Later on, partial antireflux procedure showed its inadequacy to assure a good protection from reflux at a long-term follow-up[35-37]. Livingston[38] reported a 1.4% recurrence rate of reflux in patients with total fundoplication versus 6.7% in those with partial fundoplication. At a long-term follow-up, Fernando[39] observed that 38% of Toupet patients used PPI versus 20% with Nissen. Jobe[40], in a ten years follow-up, noted a recurrence rate for reflux until 51% in patients treated with partial fundoplication (Toupet and Dor). Moreover, total fundoplication seems not to determinate a higher incidence of postoperative dysphagia compared with the partial wraps, even in patients with impaired peristalsis[41,42]. Patti[43] analysed the long-term results of patients treated with partial versus total antireflux procedures: efficacy was higher for total fundoplication (recurrence of reflux in 4% of patients with total fundoplication versus 19% in patients with partial fundoplication), while the incidence of postoperative dysphagia was similar in both groups, even in patients with impaired esophageal peristalsis (8% Toupet versus 9% Nissen). Pessaux[44], at a three-month follow-up, noted a dysphagia rate of 4.2% in patients treated with Nissen fundoplication versus 5.9% with Nissen-Rossetti wrap and 6.9% in those treated with Toupet. In a prospective randomized trial, Bessell[45] concluded that calibrating the antireflux wrap according to esophageal motility was not necessary, because the postoperative persistent dysphagia rate was similar between patients with total or partial wrap. Velanovich[46] did not find any statistically significant difference in postoperative dysphagia rate related to esophageal motility disorders (MD) (15.8% MD+ versus 16.4% MD-) in a group of patients undergoing total fundoplication.

Besides, total wrap seems to bring about an improvement of esophageal peristalsis. Heider[47] observed an increase of 47% of mean peristaltic waves in distal esophagus compared with preoperative time ($P < 0.01$), with the normalization of the esophageal motility in 74% of patients. Diaz de Liano[48], at 1 year follow-up, noted an augment of esophageal peristalsis in 43% of patients with impaired peristalsis undergoing total fundoplication. Scheffer[49] showed an increase of mean amplitude of peristalsis from a preoperative value of 57 mmHg to 86 mmHg at 3 mo follow-up and 92 mmHg at 2 years after surgery in a group of 34 patients. Oleynikov[50] in a trial comparing total and partial fundoplication noticed that in patients undergoing partial wrap, the mean amplitude of peristaltic waves increased from 27.8 mmHg before surgery to 35.6 mmHg postoperatively ($P > 0.05$), while in patients treated with total fundoplication, these values were respectively 28.2 mmHg versus 49.0 mmHg ($P < 0.05$). These evidences strongly support the choice of performing a total fundoplication also in elderly patients, which is often affected by severe impairment of esophageal peristalsis.

Our choice since 1972, has always been favorable to the total fundoplication, without section of short gastric vessel. We usually perform intraoperative endoscopy and manometry in order to calibrate antireflux wrap[51]. Usually, we calibrate the n-HPZ at values ranging from 20 to 45 mmHg ('hypercalibrated Nissen'), building the wrap around the gastroscope (with a diameter of 9 mm). This hypercalibration, in contrast with the 'floppy Nissen' of Donahue and DeMeester[52], resulted from the retrospective evaluation of a former series in which we used to calibrate the fundoplication to pressure values similar to those of a normal sphincter ('normocalibrated Nissen': 10-20 mmHg). This experience was followed by a high rate of gastroesophageal reflux recurrence (28.5%) in the first 12 mo after surgery[51], demonstrating that high pressure zone (HPZ) values of the Nissen-Rossetti wrap decrease after surgery with time (Figure 1). It is effective to

protect from GERD while avoiding a persistent dysphagia because a routine intraoperative manometric control of the wrap is always performed at the end of the procedure. Our preference for total calibrated wrap led us to consider it also in the treatment of patients affected with severe motility disorders such as achalasia and epiphrenic diverticula with excellent results[52,53].

In conclusion, laparoscopic antireflux surgery, is a safe and effective treatment for GERD even in elderly patients warranting low morbidity and mortality rates and a significant improvement of symptoms comparable to younger patients. Preoperative defective esophageal peristalsis is not a contraindication to total laparoscopic fundoplication.

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