

Laparoscopic Surgery of Gastroesophageal Reflux in Children



Cirurgia Laparoscópica do Refluxo Gastroesofágico na Criança

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ABSTRACT

Introduction: Gastroesophageal reflux is a common but usually innocuous condition in children. However, in the presence of Gastroesophageal reflux disease, the surgical treatment (open or laparoscopic) may be indicated. This study aimed to evaluate the feasibility, effectiveness and safety of laparoscopic antireflux surgery (Nissen fundoplication) with emphasis in infants.

Material and Methods: Children with gastroesophageal reflux proposed for laparoscopic antireflux surgery between January 2006 and December 2012 in a pediatric surgery department of a university hospital were studied. A descriptive and comparative analysis was conducted with regard to age (group I: <1 year, group II: 1-3 years, group III: > 3 years) and presence of comorbidities. Demographics, symptoms, comorbidities, operative indications, perioperative and postoperative outcome were assessed. The statistical significance level was set at 5%.

Results: 55 children were proposed for surgery: 12 of group I, 15 group of II and 28 of group III. 50.9% had comorbidities (21 central nervous system disease and 7 esophageal atresia). In 52 (94.5%) cases, antireflux surgery was performed by laparoscopy. The procedure lasted 167 ± 42 minutes, with no significant differences according to age groups, although higher in those with central nervous system disease. With a follow-up of 35.5 ± 23.9 months, the following complications occurred: gas-bloat syndrome, dumping or dysphagia in 8 cases (15.7%) and paraesophageal hernia in 2 cases (3.9%), with no significant differences between groups; there was clinical recurrence with reoperation in 2 cases.

Conclusion: Laparoscopic Nissen fundoplication is a feasible and effective procedure, with minimal morbidity, including in infancy.

Keywords: Child; Gastroesophageal Reflux; Laparoscopy; Fundoplication; Portugal; Surgical Procedures, Minimally Invasive.

RESUMO

Introdução: O refluxo gastroesofágico na criança é frequente e geralmente inócua. Contudo, perante doença de refluxo gastroesofágico pode impor-se o tratamento cirúrgico, o qual pode ser realizado por via clássica ou laparoscópica. No presente estudo pretende-se avaliar a exequibilidade, eficácia e segurança da cirurgia antirrefluxo (funduplicatura de Nissen) por via laparoscópica com ênfase no recém-nascido, lactente e primeira infância.

Material e Métodos: Estudaram-se as crianças com refluxo gastroesofágico propostas para cirurgia por via laparoscópica entre janeiro 2006 e dezembro 2012 num Serviço de Cirurgia Pediátrica de um Hospital universitário. Realizou-se uma análise descritiva e comparativa por faixa etária (grupo I: <1 ano, grupo II: 1-3 anos, grupo III: > 3 anos) e presença de comorbilidades. Foram avaliados os seguintes parâmetros: demografia, sintomatologia, comorbilidades, indicações operatórias, perioperatório e evolução pós-operatória. Foi assumido um nível de significância de 5%.

Resultados: Foram propostas 55 crianças, das quais 12 do grupo I, 15 do grupo II e 28 do grupo III. 50,9% apresentavam comorbilidades (21 com doença do sistema nervoso central e sete com atresia esofágica). Em 52 (94,5%) casos, a cirurgia foi exequível exclusivamente por via laparoscópica. A duração do procedimento foi de 167 ± 42 minutos, sem diferenças significativas entre grupos etários, mas superior na doença do sistema nervoso central. Com um seguimento de 35,5 ± 23,9 meses, ocorreram as seguintes complicações: síndrome de *gas-bloat*, dumping e disfagia em oito casos (15,7%) e hérniaparaesofágica em dois casos (3,9%), sem diferenças significativas entre os grupos; verificou-se recidiva clínica com reoperação em dois casos.

Conclusão: A funduplicatura de Nissen laparoscópica é um procedimento exequível, eficaz e com baixa morbilidade, inclusive em recém-nascidos, lactentes e na primeira infância.

Palavras-chave: Criança; Funduplicatura; Laparoscopia; Procedimentos Cirúrgicos Minimamente Invasivos; Portugal; Refluxo Gastroesofágico.

INTRODUCTION

Gastroesophageal reflux disease (GERD) is one of the most frequent reasons to visit a reference pediatric centre.¹ Even though gastroesophageal reflux (GER) is generally harmless, it may develop into a serious condition, namely esophagitis, highlighting the importance of an early diagnosis and treatment.²⁻⁶

The approach to GERD should be stratified, and it may include lifestyle changes, drug treatment and anti-

reflux surgery.^{7,8} In theory, GERD surgical treatment should be considered upon failure of conservative measures.^{6,9} Nevertheless, for some authors, the presence of complications as peptic stenosis, Barrett oesophagus and apparent life-threatening events (ALTE) may be considered *ab initio* surgical indications.^{6,9-13}

The anti-reflux surgery is commonly performed in pediatric surgery centres.^{6,8,12-18} Surgical approach may

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follow a classical approach (laparotomy) or be performed through laparoscopy, although the latter is assumed by most authors as a gold standard.^{6,9,10,16,17,19}

Several studies have demonstrated the efficacy and safety of fundoplication by laparoscopic approach in children as well as the advantages of this kind of approach.^{9,12,14,16} Nevertheless, its feasibility, efficacy and safety are still under discussion, mainly in early childhood, in the infant and in the newborn.^{6,13,14}

In the present study we intend to characterise a pediatric population with GER submitted to surgery, with the main purpose of assessing the feasibility, efficacy and morbidity of laparoscopic surgery in newborn babies, infants and in early childhood.

MATERIAL AND METHODS

The study describes GERD patients proposed for laparoscopic surgery in a Pediatric Surgery Department of a University Hospital, between Jan 2006 and Dec 2012. The surgical technique consisted in a total fundoplication (floppy Nissen fundoplication), followed by the placement of a percutaneous endoscopic gastrostomy feeding tube in patients with a swallowing disorder. Surgical indications included: medical treatment failure or presence of peptic stenosis, Barrett oesophagus or ALTE episodes.

The study was approved by the hospital Ethics Committee after which data was collected regarding: demography (age, gender, body weight), symptomatology, comorbidities such as central nervous system (CNS) disease and oesophageal atresia (OA), surgical indications, peri-operative period (type of surgery, surgical procedure duration, associated procedures, intra-surgical complications and duration of stay), as well as post-surgical course (efficacy and complications).

Beyond the descriptive analysis, a comparative analysis was made between three groups of patients, according to the age group: Group I (newborn and infants, 0-12 months), Group II (early childhood, 12-36 months) and Group III (3-18 years).

A comparative analysis was also made in order to determine the influence of factors such as the presence of a CNS disease, gastrostomy feeding tube placement and previous OA.

The presented values correspond to the mean \pm standard deviation for the continuous variables and the frequencies for the categorical variables. The continuous variables statistical analysis used t-student test (independent), ANOVA and Kruskal-Wallis tests as appropriate, and the Kolmogorov-Smirnov test was used to test the normality of variable distribution. The categorical variables were analysed using Chi-square test or Fisher exact test. The significance level (p) defined was 5%. The statistical analysis used IBM SPSS Statistics 20[®] software.

RESULTS

Fifty five patients were proposed for anti-reflux laparoscopic surgery: 12 (21.8%) belonged to group

I (newborn and infants), 15 (27.3%) to group II (early childhood) and 28 (50.9%) to group III (> three years); its demographic and clinical characterization is shown in Table 1.

In this study, there was a male predominance in all groups. Body weight varied between 2.4 and 60 kg. CNS disease and previous OA were the most common comorbidities, particularly in groups II and III. Patients in early childhood had the highest comorbidities prevalence (73.3%).

Digestive symptoms were the most frequent as a whole. A substantial frequency of infants presented with respiratory symptoms (50%).

GERD refractory to medical treatment was the most frequent surgery indication (81.8%), with substantial differences between age groups (Table 2). The presence of ALTE only occurred in group I patients, in a similar frequency to the GERD refractory to medical treatment. All patients in group II were proposed for surgery due to failure of medical treatment. The presence of peptic stenosis and Barrett oesophagus constituted an *ab initio* surgical indication in group III patients alone.

The surgical procedure was exclusively performed by laparoscopic approach in 52 (94.5%) patients (Fig. 1), without any statistical significant differences between the groups in the frequency of conversion to laparotomy. Conversion to laparotomy was in one patient due to material malfunction and in two patients due to a technical aspect associated with the presence of postoperative adhesions and/or previous gastrostomy. The rate of conversion to laparotomy was likewise not significantly affected by the presence of a CNS disease [2/21 (9.5%) vs. 1/34 (2.9%), $p = 0.323$] or by the presence of previous OA [0/7 (0%) vs. 3/48 (6.2%), $p = 0.659$].

A gastrostomy feeding tube was placed in 14 of the exclusively laparoscopic approach operated patients (26.9%), with a higher proportion in the groups II and III (Table 3). Gastrostomy feeding tube placement was significantly higher in patients with a CNS disease [13/19 (68.4%) vs. 1/33 (3%), $p < 0.001$].

Laparoscopic procedure duration was 167 ± 42 minutes, a minimum duration of 95 minutes and a maximum of 315 minutes, with no significant differences between the groups. The procedure duration was higher in the patients in whom a gastrostomy feeding tube was placed (186 ± 49 vs. 160 ± 39 minutes, $p = 0.056$). The presence of a CNS disease significantly increased surgery duration (190 ± 482 vs. 154 ± 34 minutes, $p = 0.002$). In the patients with previous OA, surgery duration was significantly lower (138 ± 24 vs. 172 ± 43 minutes, $p = 0.049$).

Two intra-operative complications occurred: one patient from group I suffered a laceration of the cardia and one patient from group III presented a superficial spleen laceration, having both been corrected without the need of conversion to laparotomy.

The length of in-hospital stay was 3.9 ± 2.6 days (varying between 1 and 17 days), with no significant

Table 1 - Demography, comorbidities and symptomatology

	N	Age (months)	Gender (M / F)	Body weight (Kg)	Comorbidities			Symptoms		
					CNSdis n (%)	OA n (%)	Digestive n (%)	Respiratory n (%)	Both n (%)	
Group I	12	5.3 ± 4.2	9 (75%) / 3	5.7 ± 2.3 [2.7 - 9.6]	2 (16.7%)	0 (0%)	6 (50%)	5 (41.7%)	1 (8.3%)	
Group II	15	23.9 ± 7.7	9 (60%) / 6	8.5 ± 2.7 [2.4 - 12.5]	6 (40%)	5 (33.3%)	9 (60%)	2 (13.3%)	4 (26.7%)	
Group III	28	98.6 ± 53.9	17 (60.7%) / 11	25.4 ± 16.2 [8 - 60]	13 (46.4%)	2 (7.1 %)	18 (64.3%)	2 (7.1%)	8 (28.6%)	
Global	55	57.8 ± 57.1 [0 - 205]	35 (63.6%) / 20	16.1 ± 14.6 [2.4 - 60]	21 (38.2%)	7 (12.7%)	33 (60%)	9 (16.4%)	13 (23.6%)	

Legend: Group I – infant; Group II – early childhood; Group III - > 3 years; M- male; F- female; CNSdis – central nervous system disorder; OA – oesophageal atresia. In square brackets - limit values of the sample

Table 2 - Indication for surgery

	Medical treatment failure n (%)	Peptic stenosis / Barrett oesophagus n (%)	ALTE n (%)
Group I	6 (50%)	0 (0%)	6 (50%)
Group II	15 (100%)	0 (0%)	0 (0%)
Group III	24 (85.7%)	4 (14.3%)	0 (0%)
Global	45 (81.8%)	4 (7.3%)	6 (10.9%)

Legend: Group I – infant; Group II – early childhood; Group III - > 3 years; GERD – gastroesophageal disease; ALTE- apparent life-threatening event

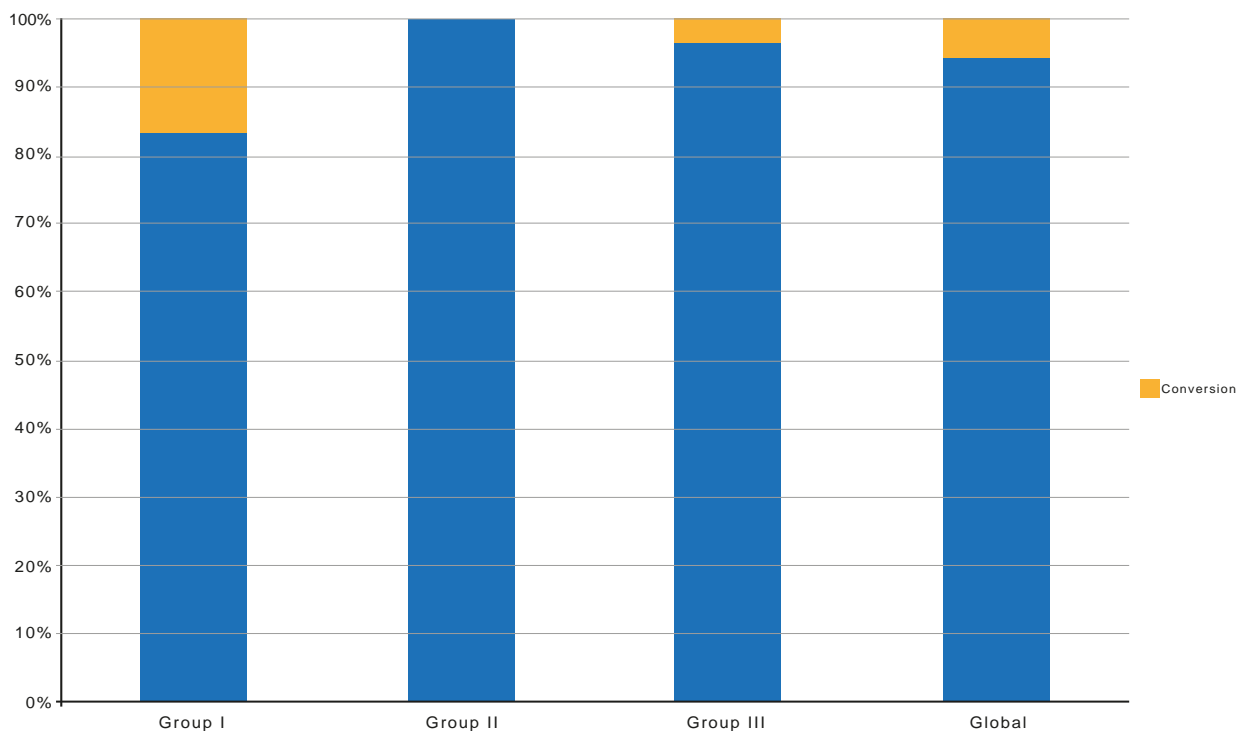


Figure 1 - Laparoscopic anti-reflux surgery

statistical differences between the three groups or between patients with and without previous OA. The duration of the in-hospital stay was significantly higher in the patients with a CNS disease (5.1 ± 3.7 vs. 3.3 ± 1.4 days, $p = 0.024$).

One patient from group III was not followed in our hospital and as such was excluded from the described results ($n = 51$). The time of follow-up of the patients was 35.5 ± 23.9 months (Table 4).

Surgical complications were documented in two patients from group I: one developed post-operative *dumping* and another "gas-bloat" syndrome. All infants presented in good health, with no clinical relapse, although the time of follow-up was shorter. A "gas-bloat" syndrome occurred in one patient and a para-oesophageal hernia in two patients from group II. These complications were responsible for a GERD relapse and required a re-operation. Three cases of "gas-bloat" syndrome occurred in group III and two cases of dysphagia. There were no clinical relapses.

We did not observe any statistically significant difference in the occurrence of complications, symptom relapse or re-operation indication between the three groups of patients, irrespective of CNS disease or previous OA.

DISCUSSION

RGE is generally harmless in the infant and in early childhood due to physiological compensatory mechanisms.²⁰ Nevertheless, when there is a GERD, close monitoring is advisable as possible complications may arise.^{4,15,20}

GERD approach may require anti-reflux surgery. Surgical indications are not unanimous.^{8,11,12,20} In our group of patients, besides medical treatment failure, the presence of an *ab initio* peptic stenosis, Barrett oesophagus and episodes of ALTE were also considered to be surgical indications. Although it may be justifiable that the maturity of the anti-reflux barrier may prevent the occurrence of episodes of ALTE, esophagitis, although uncommon in young children, may rapidly lead to stenosis and to a Barrett oesophagus.^{5,6,8-11,20} It needs to be stressed that medical/conservative treatment perspectives are more gloomy in children with comorbidities, namely with CNS diseases or previous OA, in whom GER has an increased prevalence (65-70% and 30-80%, respectively) and severity.^{2,3,8,13,16,20,21}

As regards OA, almost every component involved in the anti-reflux barrier development may be compromised. The development of GER and its complications is fostered by the shortening of the abdominal oesophageal segment (with a reduction of the angle of His, related with the traction deformity of the distal segment when oesophageal transit of the distal segment is surgically re-established) and the oesophageal motility disorders (associated to the congenital component and acquired by the surgical lesion).^{6,8,13,22-24}

Patients with a CNS disease also have an increased prevalence of GERD, multifactorial in origin, namely due to CNS dysfunction, laryngo-pharyngeal incoordination, oesophageal dysmotility, intra-abdominal pressure increase due to spasticity, delayed gastric emptying, intra-gastric

Table 3 - Laparoscopic surgery

N	Gastrostomy feeding tube placement n (%)	Duration of procedure (minutes)		Intraoperative complications n (%)	Stay duration (days)	
		Without gastrostomy	With gastrostomy			
Group I	10	1 (10.0%)	145 ± 29 [115 - 200]	150	1 (10%)	3.3 ± 1.5 [2 - 7]
Group II	15	4 (26.7%)	169 ± 42 [95 - 265]	190 ± 35 [162 - 240]	0 (0%)	3.4 ± 1.1 [1 - 6]
Group III	27	9 (33.3%)	163 ± 40 [95 - 250]	188 ± 57 [125 - 315]	1 (3.7%)	4.52 ± 3.4 [2 - 17]
Global	52	14 (26.9%)	160 ± 39 [95 - 265]	186 ± 49 [125 - 315]	2 (3.8%)	3.96 ± 2.61 [1 - 17]

Legend: Group I – infants; Group II – early childhood; Group III - > 3 years. In square brackets – limit values of the sample

Tabela 4 - Postoperative follow-up

N	Duration (months)	Clinical relapse n (%)	Complications n (%)		Reoperations n (%)	
			Functional*	Para-oesophageal hernia		
Group I	10	10.8 ± 5.9	0 (0%)	2 (20%)	0 (0%)	0 (0%)
Group II	15	46.2 ± 19.8	2 (13%)	1 (6.7%)	2 (13.3%)	2 (13.3%)
Group III	26	38.9 ± 24.4	0 (0%)	5 (19.2%)	0 (0%)	0 (0%)
Global	51	35.5 ± 23.9	2 (3.9%)	8 (15.7%)	2 (3.9%)	2 (3.9%)

Legend: Group I – infant; Group II – early childhood; Group III - > 3 years; *"gas-bloat" syndrome, dumping and dysphagia

pressure increase or scoliosis, among others.^{8,13,25-27}

When there is an indication for GERD surgical treatment and despite the fact that there is still no *gold standard*, the option of minimally invasive surgery is becoming increasingly more advantageous, associated with a shorter in-hospital, an earlier introduction of oral feeding and reduced need for post-operative analgesia, with an apparently similar efficacy to the classical surgical approach.^{12,16,17}

Feasibility, safety and efficacy of minimally invasive surgery in the newborn and in the infant patient are a controversial area, with a questionable role for laparoscopic anti-reflux surgery.^{14,20}

The absence of significant differences between the analysed age groups as regards conversion to laparotomy, rate of exclusively laparoscopic procedures (94.5%), procedure duration and intra-operative complications rate supports the feasibility of this technique in younger children. In what concerns safety, the complication rate was low (without differences between the age groups) and the stay duration was similar in the different age groups, reinforcing the role of laparoscopic surgery.

The efficacy of symptomatic control was 96.1%. Despite the complications (generally minor and transient), it is important to consider that anti-reflux surgery controls symptoms in an efficient way, with a relevant improvement in the patients and carers' quality of life.^{6,16,18,20}

Regardless of the age, the presence of comorbidities is a major risk factor in surgical feasibility and long-term efficacy.^{10,13} In our group of patients, a previous CNS disease diagnosis did not have any significant impact on the rate of conversion to laparotomy or the number of iatrogenic surgical events, a fact which reinforces the feasibility and safety of laparoscopic anti-reflux surgery in these children.

The completion of associated procedures, namely the gastrostomy feeding tube placement, was significantly higher in early childhood and in patients above the age of three years, what is related with a higher frequency of a CNS disease in these age groups. The gastrostomy does not seem to be an independent factor in the complications occurrence, despite the substantial increase in laparoscopic

procedure duration.^{13,28} These results were confirmed in our group of patients. A significant increase in the duration of stay occurred in children with a CNS disease, probably correlated with the underlying disease. In this group, some authors describe a particularly high risk of post-operative complications, worse long-term results, higher symptom relapse risk and higher mortality.^{9,10,12,13,16,20} However, these results vary greatly.^{10-12,16} In our group of patients, with a medium term post-operative follow-up, anti-reflux surgery in children with a CNS disease did not have a higher clinical relapse frequency or re-operation rate, supporting the role of GER surgical treatment in this group of patients.

In what regards OA, surgical treatment is also assumed as less effective.^{11,13,20} Nevertheless, the two cases of relapse observed in our group of patients were due to a para-oesophageal hernia occurrence in children without CNS disease or previous OA.

Gastric drainage procedures (pyloroplasty/pyloromyotomy), justified by the high prevalence of a slow gastric emptying, particularly in children with a CNS disease, is a controversial aspect.^{6,21,27,29} Despite the pathophysiological role of a slow gastric emptying in GER,^{21,27,29} none of our patients has been submitted to pyloroplasty/pyloromyotomy, as it has been already demonstrated that a slow gastric emptying tends to return to normal upon anti-reflux surgery.^{30,31}

CONCLUSION

The results in our group of patients confirm feasibility, efficacy and safety of anti-reflux laparoscopic surgery in infancy and in early childhood, as well as in children with comorbidities such as a CNS disease or previous OA.

CONFLICTS OF INTEREST

The authors declare no conflict of interest in writing the present manuscript.

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REFERENCES

1. Campanozzi A, Boccia G, Pensabene L, Panetta F, Marseglia A, Strisciuglio P, et al. Prevalence and natural history of gastroesophageal reflux: pediatric prospective survey. *Pediatrics*. 2009;123:779-83.
2. Gold BD. Review article: epidemiology and management of gastro-oesophageal reflux in children. *Aliment Pharmacol Ther*. 2004;19:s22-7.
3. Sherman PM, Hassall E, Fagundes-Neto U, Gold BD, Kato S, Koletzko S, et al. A global, evidence-based consensus on the definition of gastroesophageal reflux disease in the pediatric population. *Am J Gastroenterol*. 2009;104:1278-95.
4. Vakil N. Disease definition, clinical manifestations, epidemiology and natural history of GERD. *Best Pract Res Clin Gastroenterol*. 2010;24:759-64.
5. Jeurnink SM, van Herwaarden-Lindeboom MY, Siersema PD, Fischer K, Houwen RH, van der Zee DC. Barrett's esophagus in children: does it need more attention? *Dig Liver Dis*. 2011;43:682-7.
6. Estevão-Costa J. Tratamento cirúrgico do refluxo gastro-esofágico. *Arq Port Cir*. 2000;9:93-9.
7. Chawla S, Seth D, Mahajan P, Kamat D. Gastroesophageal reflux disorder: a review for primary care providers. *Clin Pediatr*. 2006;45:7-13.
8. Iwanaka T, Kanamori Y, Sugiyama M, Komura M, Tanaka Y, Kodaka T, et al. Laparoscopic fundoplication for gastroesophageal reflux disease in infants and children. *Surg Today*. 2010;40:393-7.
9. IPEG guidelines for the surgical treatment of pediatric gastroesophageal reflux disease (GERD). *J Laparoendosc Adv Surg Tech A*. 2009;19:sx-xiii.
10. Lasser MS, Liao JG, Burd RS. National trends in the use of antireflux procedures for children. *Pediatrics*. 2006;118:1828-35.
11. Tovar JA, Luis AL, Encinas JL, Burgos L, Pederiva F, Martinez L, et al. Pediatric surgeons and gastroesophageal reflux. *J Pediatr Surg*. 2007;42:277-83.
12. Kane TD, Brown MF, Chen MK. Position paper on laparoscopic antireflux operations in infants and children for gastroesophageal reflux disease. *J Pediatr Surg*. 2009;44:1034-40.
13. Lobe TE. The current role of laparoscopic surgery for gastroesophageal reflux disease in infants and children. *Surg Endosc*. 2007;21:167-74.
14. Shah SR, Jegapragasan M, Fox MD, Prince JM, Segura BJ, Kane TD.

A review of laparoscopic Nissen fundoplication in children weighing less than 5 kg. *J Pediatr Surg.* 2010;45:1165-8.

15. LaRiviere CA, Parimi C, Huaco JC, Acierno SA, Garrison MM, Goldin AB. Variations in preoperative decision making for antireflux procedures in pediatric gastroesophageal reflux disease: a survey of pediatric surgeons. *J Pediatr Surg.* 2011;46:1093-8.
16. Mauritz FA, van Herwaarden-Lindeboom MY, Stomp W, Zwaveling S, Fischer K, Houwen RH, et al. The effects and efficacy of antireflux surgery in children with gastroesophageal reflux disease: a systematic review. *J Gastrointest Surg.* 2011;15:1872-8.
17. Esposito C, Montupet P, Reinberg O. Laparoscopic surgery for gastroesophageal reflux disease during the first year of life. *J Pediatr Surg.* 2001;36:715-7.
18. Kane TD. Laparoscopic Nissen fundoplication. *Minerva Chir.* 2009;64:147-57.
19. Tannuri AC, Tannuri U, Mathias AL, Velhote MC, Romao RL, Goncalves ME, et al. Gastroesophageal reflux disease in children: efficacy of Nissen fundoplication in treating digestive and respiratory symptoms. Experience of a single center. *Dis Esophagus.* 2008;21:746-50.
20. Pacilli M, Chowdhury MM, Pierro A. The surgical treatment of gastro-esophageal reflux in neonates and infants. *Semin Pediatr Surg.* 2005;14:34-41.
21. Estevão-Costa J, Dias JA, Campos M, Trindade E, Teixeira-Pinto A, Carvalho JL. Can esophageal pH monitoring predict delayed gastric emptying? *J Pediatr Surg.* 2004;39:1537-40.
22. Pinheiro PF, Simoes e Silva AC, Pereira RM. Current knowledge on esophageal atresia. *World J Gastroenterol.* 2012;18:3662-72.
23. Sistonen SJ, Pakarinen MP, Rintala RJ. Long-term results of esophageal atresia: Helsinki experience and review of literature. *Pediatr Surg Int.* 2011;27:1141-9.
24. Hassall E. Esophagitis and Barrett esophagus: unifying the definitions and diagnostic approaches, with special reference to esophageal atresia. *J Pediatr Gastroenterol Nutr.* 2011;52:S23-6.
25. Sullivan PB. Gastrointestinal problems in the neurologically impaired child. *Baillieres Clin Gastroenterol.* 1997;11:529-46.
26. Pensabene L, Miele E, Del Giudice E, Strisciunglio C, Staiano A. Mechanisms of gastroesophageal reflux in children with sequelae of birth asphyxia. *Brain Dev.* 2008;30:563-71.
27. Estevão-Costa J. Gastric emptying and pediatric gastroesophageal reflux. In: Esposito C, Montupet P, Rothenberg S, editors. *The Gastroesophageal Reflux in Infants and Children.* Berlin: Springer-Verlag; 2004. p.135-45.
28. Kawahara H, Mitani Y, Nose K, Nakai H, Yoneda A, Kubota A, et al. Should fundoplication be added at the time of gastrostomy placement in patients who are neurologically impaired? *J Pediatr Surg.* 2010;45:2373-6.
29. Estevão-Costa J, Campos M, Dias JA, Trindade E, Medina AM, Carvalho JL. Delayed gastric emptying and gastroesophageal reflux: a pathophysiologic relationship. *J Pediatr Gastroenterol Nutr.* 2001;32:471-4.
30. Estevão-Costa J, Fragoso AC, Prata MJ, Campos M, Trindade E, Dias JA, et al. Gastric emptying and antireflux surgery. *Pediatr Surg Int.* 2011;27:367-71.
31. Pacilli M, Pierro A, Lindley KJ, Curry JI, Eaton S. Gastric emptying is accelerated following laparoscopic Nissen fundoplication. *Eur J Pediatr Surg.* 2008;18:395-7.

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