

Diagnostic Yield of Endoscopic Procedures in Children: Experience of a Portuguese Center

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Keywords

Endoscopic procedure · Esophago-gastro-duodenoscopy · Ileo-colonoscopy · Diagnostic yield

Abstract

Background: Over the last decades, the use of gastrointestinal (GI) endoscopic procedures has been increased in children worldwide, allowing the early diagnosis and therapeutic intervention in multiple GI diseases. **Aims and Methods:** In order to evaluate the appropriateness and the diagnostic yield of initial GI endoscopic techniques in children in a Portuguese tertiary hospital, we performed a retrospective cohort study during a 12-month period. **Results:** A total of 308 procedures were performed in 276 patients; the median age was 11 years and 50.4% were males. Esophago-gastro-duodenoscopy (EGD) corresponded to 81.8% of the procedures and ileo-colonoscopy (IC) to the remaining; 11.6% of the patients underwent both EGD and IC. Overall, 51.3% of the exams showed abnormal macroscopic findings, and 69.6% showed histopathological signs of disease, with IC showing significantly more positive results than EGD ($p < 0.05$). Considering the different indications independently, abnormal

serology for celiac disease, suspected ingestion of foreign bodies, suspected inflammatory bowel disease, and food impaction were frequent in our population; and in the majority of the cases, the suspected diagnosis was confirmed: celiac disease, ingestion of foreign bodies, inflammatory bowel disease, and eosinophilic esophagitis, respectively. On the other hand, despite the high frequency of epigastric pain in this population, only nearly one-third of the patients showed abnormal histological findings. The final diagnosis was established in 63% of the patients, and 39.1% initiated the new treatment. **Discussion:** Our results emphasize the importance of endoscopic procedures, especially IC, in the diagnosis of GI diseases in pediatric patients, as well as the careful choice of the endoscopic techniques in those with less specific symptoms, as chronic abdominal pain. In this particular situation, given the proportion of cases that may be due to functional disease, good characterization of the clinical context is needed, and endoscopy should be reserved for a second-line approach. **Conclusion:** It is important to monitor and examine the endoscopic techniques as an index of quality criteria for clinical practice.

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Rentabilidade diagnóstica dos procedimentos endoscópicos em crianças: experiência de um centro Português

Palavras Chave

Procedimento endoscópico · Esófago-gastro-duodenoscopia · Ileo-colonoscopia · Rentabilidade diagnóstica

Resumo

Introdução: Ao longo das últimas décadas, a utilização dos procedimentos endoscópicos gastrointestinais (GI) nas crianças tem aumentado globalmente, permitindo o diagnóstico precoce e a intervenção terapêutica em múltiplas doenças GI. **Objetivos e Métodos:** Por forma a avaliar a adequabilidade e a rentabilidade diagnóstica na utilização de técnicas endoscópicas GI iniciais em crianças, realizamos um estudo retrospectivo de coorte durante um período de 12 meses num hospital terciário Português. **Resultados:** Foram realizados 308 procedimentos em 276 doentes, a idade mediana foi 11 anos e 50.4% eram do sexo masculino. As esófago-gastro-duodenoscopias (EGD) corresponderam a 81.8% dos procedimentos e as ileo-colonoscopias (IC) aos restantes; 11.6% dos doentes foram submetidos aos dois exames. No total, 51.3% dos exames mostraram alterações macroscópicas e 69.6% mostraram sinais histopatológicos de doença, com as IC a mostrar significativamente mais resultados positivos que as EGD ($p < 0.05$). Considerando as diferentes indicações independentemente, a presença de serologias positivas para doença celíaca, a suspeita de ingestão de corpos estranhos, a suspeita de doença inflamatória intestinal e a impação alimentar foram frequentes na nossa população, e na maioria dos casos a suspeita diagnóstica foi confirmada: doença celíaca, ingestão de corpo estranho, doença inflamatória intestinal e esofagite eosinofílica, respetivamente. Por outro lado, apesar da elevada frequência de doentes com dor epigástrica a motivar o estudo endoscópico, apenas em perto de um terço dos mesmos encontrou-se alterações histológicas. O diagnóstico final foi estabelecido em 63, e 39.1% dos doentes iniciaram novo tratamento. **Discussão:** Os resultados obtidos enfatizam a importância da utilização de técnicas endoscópicas, particularmente a IC, no diagnóstico de doenças GI nos doentes pediátricos, e da escolha criteriosa das mesmas nos doentes com sintomas menos específicos como dor abdominal crónica. Nesta situação particular, dada a proporção de casos que podem dever-se a doença funcional,

uma boa caracterização do contexto clínico é essencial, e a endoscopia deve ser reservada para uma segunda linha de abordagem diagnóstica. **Conclusão:** A monitorização e a auditoria dos exames endoscópicos são importantes, como um índice de qualidade para a prática clínica.

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Introduction

Diagnostic gastrointestinal (GI) endoscopy plays an important role in the evaluation of symptoms and in the pathological description of GI diseases in children [1]. There has been an increased use of esophago-gastro-duodenoscopy (EGD) and ileo-colonoscopy (IC) in children worldwide, parallel to the improvement of experience and knowledge in the last decades [2]. Easy accessibility and a low complication rate of those techniques in noncomplex pediatric patients has caused a considerable rise in their use as well as in the health cost associated with those procedures [3]. Disorders that require endoscopy in the diagnostic algorithm have shown a rising incidence of diagnosis and use of those techniques as a tool for treatment [2]. On the other hand, according to Franciosi et al. [2], from 1985 to 2005, there has been a 12-fold rise in the number of first-time procedures done, with increased use in patients with nonspecific symptoms and a decline in the frequency of most severe presentations such as GI bleeding [2]. This places a spotlight on the appropriateness and cost-effectiveness of these procedures.

In order to critically assess the appropriateness and diagnostic yield of endoscopy, a retrospective cohort study was performed to evaluate the initial GI endoscopy practice at a Portuguese tertiary referral center for pediatric gastroenterology. The association of any negative and positive findings (macroscopic and histopathologic) with specific symptoms and the relative importance in altering management was analyzed as a secondary endpoint of the study.

Methods

We conducted a retrospective descriptive study covering a 12-month period from January to December 2018, with the inclusion of children submitted to an endoscopic procedure in a tertiary hospital in Portugal. The process was designed to identify patients undergoing initial diagnostic endoscopy. Exclusion criteria included patients younger than 1 month or older than 18 years of age. All endoscopies were performed by experienced pediatric

Table 1. Indications for the endoscopic study, and frequency of macroscopic and abnormal histologic features in 276 pediatric patients

Indication	Frequency, % (n)	Endoscopic abnormality present, % (n)	Histologic abnormality present, % (n)
Epigastric pain	15.6% (43)	23.3% (10)	30.2% (13)
Celiac antibodies	14.5% (40)	77.5% (31)	80.0% (32)
Suspected foreign body ingestion	13.0% (36)	75.0% (27)	–
Lower GI bleeding	12.0% (33)	69.7% (23)	66.7% (22)
Diarrhea and other signs and symptoms	8.7% (24)	91.7% (22)	87.5% (21)
Dysphagia	9.1% (25)	16.0% (4)	28.0% (7)
Suspected caustic ingestion	7.2% (20)	30.0% (6)	–
Food impact	6.9% (19)	68.4% (13)	73.7% (14)
Gastroesophageal reflux	5.4% (15)	20.0% (3)	33.3% (5)
Upper GI bleeding	4.0% (11)	36.4% (4)	18.2% (2)
Refractory anemia	2.5% (7)	57.1% (4)	71.4% (5)
Persisting vomits	1.8% (5)	40.0% (2)	20.0% (1)
Failure to thrive	1.1% (3)	66.7% (2)	66.7% (2)
Perianal abscess	1.1% (3)	100.0% (3)	100.0% (3)
Other (perianal condiloma, IL-10 deficit, tracheoesophageal fistula, pica, paraesophageal cyst)	1.8% (5)	40.0% (2)	20.0% (1)

gastroenterologists or by fellow trainees under the direct supervision of a senior member of the unit. Of 574 endoscopic procedures, a total of 308 (53.7%) performed in 276 patients fulfilled the inclusion criteria of an initial assessment. The medical records were reviewed. Statistical analysis was made with SPSS® Statistics v20.0. Descriptive statistics for subject characteristics and basic demographics were reported as means and standard deviations (SD) or medians with ranges depending on the variable distribution. Subject characteristics and endoscopic practices were compared using the χ^2 test for dichotomous outcome variables, odds ratio (OR) and related 95% confidence interval (CI) were calculated. A *p* value < 0.05 was considered significant.

Results

In 2018, a total of 308 initial diagnostic endoscopies (EGD and IC) were made in 276 patients. The median age was 11 years (1 month to 18 years), 139 (50.4%) were males and 68 (24.6%) under 5 years of age. A total of 252 EGD (81.8%) and 56 IC procedures were performed (18.2%). Thirty-two patients underwent both EGD and IC (11.6% of the cohort).

Suspicion of foreign body ingestion led to 36 EGD (13% of patients), with identification and removal of the object in 75% of those cases. Caustic ingestion was the cause for 20 EGD (7.2% of patients), with evidence of endoscopic lesions in 30% (caustic esophagitis, Zargar grades 1–4). Among the remaining patients, the indications that most frequently motivated a GI endoscopy were epigastric pain (15.6%), positive celiac antibodies

(14.5%), lower GI bleeding (12%), diarrhea with other signs and symptoms (8.7%), dysphagia (9.1%), and food impaction (6.9%) (Table 1). The suspicion of inflammatory bowel disease was admitted in most of the cases that presented with diarrhea and/or low GI bleeding accompanied by other findings such as perianal abscess, generalized abdominal pain, failure to thrive, and laboratory abnormalities. It was the main indication for total IC in 31 patients, with terminal ileum intubation in 29 cases (93.5%); poor bowel preparation and terminal ileum stenosis at the ileocecal valve accounted for failure in the remainder. In this group of patients, upper endoscopy was systematically performed at the diagnosis.

Overall, of the 308 endoscopies, 51.3% showed abnormal macroscopic findings, 73.2% with IC compared to 46.4% with EGD (*p* < 0.001), with a sensitivity of 93% with the IC procedure compared to 69% with the EGD procedure (with a negative predictive value of 80 vs. 48%, respectively) and a specificity of 92% with IC compared to 88% with EGD (with a positive predictive value of 98 vs. 95%, respectively). Biopsies were done in 207 procedures (excluding the cases of caustic and foreign body ingestion, only 14.6% of the remaining did not have biopsies) with 69.6% of abnormal microscopic findings, 87.2% with IC compared to 64.4% with EGD (*p* = 0.002). Regarding the indications for endoscopy, 40 patients were examined due to abnormal serology for celiac disease, and histopathology confirmed the diagnosis in 80% of the patients. In the cases with diarrhea with other signs and symptoms, histologic abnor-

Table 2. Frequency of each final diagnosis in 174 children

Diagnosis	Frequency, % (n)
Celiac disease	18.4% (32)
Foreign body ingestion	17.2% (30)
Inflammatory bowel disease	17.2% (30)
Eosinophilic esophagitis	12.1% (21)
Caustic ingestion	10.9% (19)
<i>H. pylori</i> gastritis	8.0% (14)
Gastritis	3.4% (6)
Juvenile polyp	2.9% (5)
Esophagitis	1.7% (3)
Allergic proctocolitis	1.7% (3)
Gastroduodenal ulcer	1.1% (2)
Primary immunodeficiency	1.1% (2)
Other (tracheoesophageal fistula, pica, infectious colitis, achalasia)	4.0% (7)

malities were found in 87.5% and contributed to the diagnosis (Crohn's disease, ulcerative colitis, and unclassified colitis), with positive histologic results in 69.7% of EGD and 91.7% of IC. Of 19 patients with a history of food impaction, 73.7% had a histologic diagnosis of eosinophilic esophagitis. In contrast, patients with symptoms, such as epigastric pain, gastroesophageal reflux, dysphagia, and persistent vomiting, had lower rates of positive findings in the endoscopic procedure (see Table 1). Only 30.2 and 28% of the patients with epigastralgia and dysphagia, respectively, showed abnormal histologic findings. The diagnostic yield in cases with suspected inflammatory bowel disease was 9-fold higher (OR 0.11; 95% CI 0.03–0.44), 5.4-fold in those with positive celiac antibodies (OR 0.19; 95% CI 0.66–0.53) and 4.4-fold in patients with a history of food impaction (OR 0.23; 95% CI 0.63–0.81) compared to patients that presented only with epigastric pain.

The final diagnosis was obtained in 174 (63%) patients in this cohort. The most frequent diagnoses were celiac disease in 18.4%, foreign body ingestion in 17.2%, inflammatory bowel disease (Crohn's disease, ulcerative colitis, and unclassified colitis) in 17.2%, eosinophilic esophagitis in 12.1%, caustic esophagitis in 10.9%, and *Helicobacter pylori* gastritis in 8% (Table 2). All patients with established diagnoses presented abnormal endoscopic and/or histologic findings. In 108 (39.1%) patients, a new pharmacological treatment was proposed after the procedure. Considering the patients with a diagnosis that did not need to start pharmacological treatment (66 patients), and excluding the cases of foreign body ingestion, it happened in only 20.7%, most of them having a diagnosis of caustic ingestion or gastritis.

Discussion

Although GI endoscopy contributes to a high rate of diagnosis, the proportion of normal results has been increasing in parallel with the rise in their use [2]. Thus, a more critical review in the use of this tool is needed to maximize efficacy and minimize inconvenience and risk.

The diagnostic yield can be defined as the likelihood of a procedure to provide the information required to establish a diagnosis or to have a positive effect on therapeutic decisions [1, 4]. We considered the presence of endoscopic and/or histologic abnormalities as a measure of diagnostic yield, since it corresponds to the proportion of patients in whom we achieved a final diagnosis.

Our study showed that the diagnostic yield of IC is superior compared to EGD (73.2% of macroscopic and 87.2% of microscopic positive findings in IC, compared to 46.4% of macroscopic and 64.4% of microscopic positive findings in EGD). That depends mainly on the specificity of the symptoms and on higher suspicion for a certain diagnosis that predetermines the use of those two techniques, combined to the fact that IC is a more invasive procedure, and so the indication requires more careful consideration.

Considering the most frequent indications in our study, the presence of more specific signs or symptoms in a patient's presentation, such as celiac antibodies, suspected foreign body ingestion, food impaction, and GI bleeding and/or diarrhea with other signs and symptoms, we observed a markedly higher rate of abnormal results in endoscopic and histologic findings. Therefore, a higher diagnostic yield was found compared to the nonspecific symptoms as epigastric pain. Persisting abdominal pain in childhood is a very common pediatric problem [5]. Although it was the most frequent symptom present in our population, only nearly one-third of the patients showed abnormal histologic findings. The publication of Rome criteria for functional GI disorders has had a positive impact on the appropriateness of GI endoscopy, with a significant reduction of inappropriate procedures after its publication [6, 7]. Despite of this, various authors have shown lower rates of positive findings in endoscopic procedures as we did. Aydin et al. [5] reported that 27% of all analyzed EGDs were performed due to unspecific symptoms, such as vague upper abdominal pain/discomfort, and 88% of those had a normal exam. Thakkar et al. [8] found a diagnostic yield for EGD of 38% in children with chronic abdominal pain. Sheiko et al. [9] identified endoscopic abnormalities in 28.9% and histopathological abnormalities in 35.2%. Akbulut et al. [10] reported a high

diagnostic yield of 56.2% but concluded that a significantly greater diagnostic yield of EGD was present in patients with chronic abdominal pain and alarm symptoms (65.1%) compared to those without symptoms (45.2%). Dahshan et al. [11] and Puzanovova et al. [12] highlighted the importance of a routine biopsy during the approach of chronic abdominal pain. Endoscopy should then be reserved for the second line of diagnostic intervention in those cases and complemented with an adequate number of biopsies. Considering dysphagia, we had a similarly low rate of positive findings in our investigation. This can be explained by the frequent association of this presentation with anxious behaviors about food in young children, with refusal or gagging episodes during meals. In those cases, the upper endoscopy works not only as a method to exclude other differential diagnoses but as a therapeutic tool too, stopping the cycle of fear only by showing that there is no structural problem to children and parents. In contrast, in those patients with signs and symptoms suggestive of inflammatory bowel disease, the diagnostic yield of the disease was higher than in all other suspected diagnoses.

The final diagnosis was determined in nearly two-thirds of our cohort. The most frequent diagnosis was celiac disease, foreign body ingestion, eosinophilic esophagitis, and inflammatory bowel disease. However, we reinforce that a negative finding is often as important in the management of a child with GI symptoms as a positive one, allowing to stop the use of other complementary studies with the exclusion of the suspected disease, and to reassure the absence of organic disease to children and parents.

Conclusion

This study underlies the importance of endoscopic procedures for the early diagnosis of various GI diseases in children, allowing the initiation of a correct treatment. We concluded that IC has a superior diagnostic yield compared to EGD, with a higher sensitivity and specificity. Those procedures should be judiciously chosen according to their predictable diagnostic yield, considering the specificity of the signs and symptoms of presentation. Given the proportion of cases with low specificity symptoms, such as chronic abdominal pain, which may be due to functional disease, a good interpretation of the clinical context is needed. In these cases, the endoscopy should be reserved for a second-line approach.

Furthermore, we highlight the importance of monitoring and examining the endoscopic techniques as a measure of quality criteria for clinical practice. Further studies are needed to standardize the preprocedural evaluation and identification of patients with the highest probability to have changes in their management. In addition, a better interpretation of the true risks and costs associated with pediatric endoscopy is needed.

Statement of Ethics

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. Parents/guardians have given their written informed consent, and the study protocol was approved by the institute's committee.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

S. Silva and C. Silva contributed to the conception, the design acquisition, and interpretation of data, and drafted the manuscript. M.C. Espinheira and I. Pinto Pais critically revised the manuscript and gave their final approval. E. Trindade and J. Amil Dias contributed to the conception, the design acquisition, and interpretation of data, critically revised the manuscript, and gave their final approval. All authors agreed to be accountable for all aspects of the work ensuring integrity and accuracy.

References

- 1 Thomson M, Sharma S. Diagnostic Yield of Upper and Lower Gastrointestinal Endoscopies in Children in a Tertiary Centre. *J Pediatr Gastroenterol Nutr*. 2017 Jun;64(6):903–6.
- 2 Franciosi JP, Fiorino K, Ruchelli E, Shults J, Spergel J, Liacouras CA, et al. Changing indications for upper endoscopy in children during a 20-year period. *J Pediatr Gastroenterol Nutr*. 2010 Oct;51(4):443–7.
- 3 Elitsur Y. The diagnostic yield of upper endoscopy procedures in children- is it cost effective? *Curr Gastroenterol Rep*. 2014;16(5):385.
- 4 Lee WS, Zainuddin H, Boey CC, Chai PF. Appropriateness, endoscopic findings and contributive yield of pediatric gastrointestinal endoscopy. *World J Gastroenterol*. 2013 Dec;19(47):9077–83.

- 5 Aydin M, Niggeschmidt J, Ballauff A, Wirth S, Hensel KO. [Common Indications and The Diagnostic Yield of Esophagogastroduodenoscopy in Children with Gastrointestinal Distress]. *Klin Padiatr*. 2019 Jan;231(1):21–7. German.
- 6 Miele E, Giannetti E, Martinelli M, Tramontano A, Greco L, Staiano A. Impact of the Rome II paediatric criteria on the appropriateness of the upper and lower gastrointestinal endoscopy in children. *Aliment Pharmacol Ther*. 2010 Aug;32(4):582–90.
- 7 Tam YH, Chan KW, To KF, Cheung ST, Mou JW, Pang KK, et al. Impact of pediatric Rome III criteria of functional dyspepsia on the diagnostic yield of upper endoscopy and predictors for a positive endoscopic finding. *J Pediatr Gastroenterol Nutr*. 2011 Apr;52(4):387–91.
- 8 Thakkar K, Chen L, Tatevian N, Shulman RJ, McDuffie A, Tsou M, et al. Diagnostic yield of oesophagogastroduodenoscopy in children with abdominal pain. *Aliment Pharmacol Ther*. 2009 Sep;30(6):662–9.
- 9 Sheiko MA, Feinstein JA, Capocelli KE, Kramer RE. Diagnostic yield of EGD in children: a retrospective single-center study of 1000 cases. *Gastrointest Endosc*. 2013 Jul;78(1):47–54.e1.
- 10 Akbulut UE, Emeksiz HC, Kocak FG, Livaoğlu A. Diagnostic yield of esophagogastroduodenoscopy in children with chronic abdominal pain. *Arch Med Sci*. 2018 Jan;14(1):74–80.
- 11 Dahshan A, Rabah R. Correlation of endoscopy and histology in the gastroesophageal mucosa in children: are routine biopsies justified? *J Clin Gastroenterol*. 2000 Oct;31(3):213–6.
- 12 Puzanovova M, Rudzinski E, Shirkey KC, Cherry R, Acra S, Walker LS. Sex, psychosocial factors, and reported symptoms influence referral for esophagogastroduodenoscopy and biopsy results in children with chronic abdominal pain. *J Pediatr Gastroenterol Nutr*. 2008 Jul;47(1):54–60.