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Andes pediatr. 2023;94(2):153-160
DOI: 10.32641/andespediatr.v94i2.4464

ORIGINAL ARTICLE

Upper gastrointestinal endoscopy in pediatrics: experience of a high complexity center in Latin-America

Endoscopia digestiva superior en pediatría: experiencia de un centro de alta complejidad de Latinoamérica

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Received: July 2, 2022; Approved: October 5, 2022

What do we know about the subject matter of this study?

Endoscopy is a procedure with clear diagnostic and therapeutic indications according to the guidelines for the pediatric population, with increasing use over the years, allowing the detection and treatment of pathologies of the gastrointestinal tract.

What does this study contribute to what is already known?

This study shows a significant percentage of therapeutic endoscopies, including the performance of percutaneous endoscopic gastrostomy and considering the neonatal period, with a low rate of complications. In our sphere, a significant percentage of procedures could be avoided from primary prevention.

Abstract

Objective: To characterize pediatric patients undergoing esophagogastroduodenoscopy (EGD) in a high-complexity hospital. **Patients and Method:** Retrospective study in patients under 14 years of age who underwent EGD at the Hospital San Vicente Fundación de Medellín, between January 2019 and June 2020. The following sociodemographic characteristics were evaluated: age, sex, type of health insurance, place of origin, service where the procedure was indicated, indications for endoscopy, type of care, purpose of the procedure, endoscopic findings, endoscopic intervention, complications associated with the procedure or anesthesia, and relevance of the procedure. **Results:** 466 patients who underwent 552 endoscopies were included. Fifty-seven percent of the patients were male. In diagnostic EGD, the main indications were abdominal pain (23%) and upper gastrointestinal bleeding (17%). In therapeutic EGD, the most frequently performed procedures were percutaneous endoscopic gastrostomy (41%), foreign body removal (27%), and esophageal dilation (24%). The complication rate related to the procedure was 0.5% and in relation to anesthesia was 0.7%. **Conclusions:** EGD in pediatric patients is an effective and safe tool if performed with an appropriate indication. One-third of therapeutic EGD could be avoided from primary prevention.

Keywords:
Gastrointestinal Endoscopy;
Digestive Endoscopy;
Abdominal Pain;
Gastrointestinal Bleeding;
Gastrostomy.

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Edited by:
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How to cite this article: Andes pediatr. 2023;94(2):153-160. DOI: 10.32641/andespediatr.v94i2.4464

Introduction

The implementation of digestive endoscopy in pediatrics took place in the early 70s, initially as an exclusively diagnostic technique but, thanks to technological advances, it became a procedure with both diagnostic and therapeutic utility, allowing a better approach to some gastrointestinal diseases. The etymological origin of the word endoscopy comes from the words *endo*, meaning inside, and *skopein*, meaning to observe, which would translate upper gastrointestinal endoscopy (UGE) as the direct visualization of the esophagus, stomach, and duodenum[1].

The UGE is a minimally invasive procedure that can be performed under sedation or general anesthesia, during which complications derived from the intervention or the anesthesia may occur, therefore, it should be performed when the result guides the patient's diagnosis or treatment. The European Society of Gastrointestinal Endoscopy (ESGE) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN), based on the available evidence, established the diagnostic and therapeutic indications for endoscopy, as well as the appropriate time for its performance[2]. Multiple studies have evaluated the performance of these indications, finding improvement in diagnostic efficiency when following these guidelines[3,4].

According to the report of the Latin American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (LASPGHAN), in Colombia, 19 centers perform pediatric UGE[1]. In Medellin, there are five centers for its performance. The greater availability of UGE in pediatric centers is directly related to an increase in the number of interventions. In a 20-year follow-up study, it was found an increase in the number of patients with gastrointestinal disorders requiring digestive endoscopies, with up to 12 times more being performed[5]. A Japanese study found that the number of UGE performed in pediatric patients was five times higher in the period 2011-2016 compared with the period 2000-2004[6].

The objective of this research was to characterize pediatric patients who underwent UGE in a high-complexity pediatric hospital in Medellin, Colombia.

Patients and Method

Design

Retrospective study. Pediatric patients under 14 years of age who underwent UGE at the *Hospital Infantil San Vicente Fundación* (HSVF), between January 2019 and June 2020, were included. No exclusion criteria were considered. The study was approved by the Institution's ethics committee (Act number 19-2020).

The selection process of the medical records was performed by convenience sampling based on the CUPS (unified classification of health procedures, in Spanish) codes: 431002, 441302, 452305, 423305, 429405, 960801, 422004, 970200, 434000, 429301, and 483801, which correspond to endoscopic procedures of the upper gastrointestinal tract. Subsequently, a verification of the quality of the data and correct classification of the procedures performed was carried out.

The variables included were the sociodemographic characteristics of the patients (age, sex, health insurance, place of origin, service where the procedure was indicated), indications for endoscopy, type of care (out-patient, emergency, in-patient), the purpose of the procedure (diagnostic, therapeutic or both), endoscopic findings, endoscopic intervention, complications associated with the procedure or anesthesia, the professional who performed the procedure, and the relevance of the procedure.

The equipment used to perform pediatric UGEs at the HSVF is pediatric 8.8 mm Olympus GIF-Q180, neonatal 5.9 mm Olympus EXERA GIF-XP160, and 9 mm PENTAX EG2-I10.

The technique used at the institution to perform gastrostomies was the push technique[7].

Definitions

Normal UGE: report without abnormal macroscopic findings. *Upper gastrointestinal bleeding* (UGB): bleeding originating in segments of the digestive tract above the ligament of Treitz[2]. *Esophagitis*: differentiation between esophagitis, caustic esophagitis, and eosinophilic esophagitis was made considering previous diagnosis and suggestive macroscopic findings.

Indications for UGE according to the 2017 ESPGHAN guidelines[2]: i. Diagnostic: abnormal weight loss, anemia without a clear cause, abdominal pain with a suspected organic origin, odynophagia or dysphagia, caustic ingestion, unexplained recurrent vomiting, hematemesis, hematochezia, and gastroesophageal reflux; ii. Therapeutic: ingested foreign body, endoscopic gastrostomies, esophageal dilatation, UGB, esophageal varices, achalasia, and polypectomy.

Evaluation of the UGE relevance: endoscopy performed under the above indications.

Percutaneous endoscopic gastrostomy (PEG): an endoscopic procedure that allows the creation of an alternative and safe feeding route in patients with swallowing disorders of different etiologies and in patients with medical conditions in which nutritional requirements are higher.

Indication for PEG according to ESPGHAN[7]: patients with neurological and metabolic diseases, heart disease, orofacial malformations, eating disorders, cystic fibrosis, inflammatory bowel disease, short bowel syndrome, and renal insufficiency.

Complications associated with UGE: those that were directly related to the technique of the procedure, such as perforation and bleeding.

Complications associated with anesthesia: respiratory or cardiovascular events related to the anesthetic technique or drugs used.

Data analysis

Data collection was performed in Microsoft Excel 365. A descriptive analysis was performed, categorical variables were calculated as frequencies and proportions, and for numerical variables, the normality of each variable was evaluated with the Shapiro-Wilk test and reported as medians and interquartile ranges (25th-75th percentile). SPSS 22 software was used for statistical analysis.

Results

466 patients underwent a total of 552 UGEs. 37 patients underwent two or more procedures, all of them for therapeutic purposes due to the underlying disease, mainly esophageal variceal ligation and esophageal dilation. However, the last four months of the research period coincided with the beginning of the COVID-19 pandemic, in which a decrease in the number of procedures was evidenced due to the partial closure of operating rooms due to the contingency and guidelines of the Colombian Ministry of Health.

The youngest patient was 23 days old, and 38% of the patients were younger than two years old. UGE was indicated to 125 patients in the emergency room and of these 13 (10%) were due to caustic ingestion or UGB. Table 1 describes the sociodemographic characteristics.

UGEs were indicated and performed by pediatric gastroenterology in 79% of patients, pediatric surgery in 20%, and adult gastroenterology in 1%, the latter being procedures due to caustic ingestion. In all cases, the procedure was considered relevant.

Of the 552 UGEs performed, 172 were with a diagnostic indication, 368 had a therapeutic purpose, and 12 were indicated as a diagnostic procedure but according to the findings, a therapeutic intervention was additionally performed.

Diagnostic endoscopies

Chronic abdominal pain was the most frequent indication with 23%. 13% of the patients had more than one indication for diagnostic UGE. Table 2 describes the diagnostic indications.

220 abnormal findings were found; in 23% of the procedures there was more than one abnormal finding, with gastropathy as the most frequent (31%), which was predominantly erythematous and/or nodular and mainly involved the antral region, followed by esophagitis (21%) and 17% presented no findings.

Table 1. Sociodemographic characteristics of pediatric patients who underwent an upper gastrointestinal endoscopy (UGE)

Characteristics	n = 466
Age (months), Median (IQR)	39 (13 - 84)
Male, n (%)	267 (57)
Place of origin, n (%)	
Medellin/Valle de Aburra	343 (74)
Antioquia	108 (23)
Other departments	15 (3)
Origin area, n (%)	
Urban	433 (93)
Rural	33 (7)
Health regimen, n (%)	
Government subsidized	270 (58)
Health insurance	191 (41)
Special regimen*	5 (1)
The unit when the UGE was ordered, n (%)	
In-patient care	243 (52)
Emergency	125 (27)
Out-patient care	98 (21)
Comorbidities of the patients, n (%)	238 (51)
Previous UGE, n (%)	37 (8)

IQR: interquartile rang, UGE: upper gastrointestinal endoscopy. *Special regimen: police and educators.

Table 2. Diagnostic indications for upper gastrointestinal endoscopy (UGE)

Indications*	n = 195 Frequency (%)
Chronic abdominal pain	46 (23)
Upper gastrointestinal bleeding	33 (17)
Recurrent vomiting	27 (14)
Caustic ingestion	23 (12)
Dysphagia	14 (7)
Gastroesophageal reflux	11 (6)
Others**	41 (21)

*A patient could have more than one indication. **Failure to thrive, pre-transplant kidney protocol, anemia, food allergy, suspected inflammatory bowel disease, chronic diarrhea, roundworm obstruction, intestinal lymphangiectasia.

In the procedures performed due to abdominal pain, 79% of the patients were older than 5 years, the predominant age group was schoolchildren (42%), and were mostly males. In 67% of cases, the finding was gastropathy and 16% were both without findings and esophagitis.

In the UGE indicated due to UGB, gastric ulcer was found in 24%, followed by esophageal varices and duodenal ulcer, with 21% each. These procedures were performed on 30 patients, predominantly males (63%), and the most affected age group was adolescents (40%). Table 3 describes the endoscopic results.

Therapeutic endoscopies

43% corresponded to PEG, 51% of these procedures were performed in patients younger than 12 months, and the youngest patient was 23 days old and weighed 3 kilograms. The sex ratio was 1:1. The comorbidities of these patients were: neurological disorders (54%), genetic syndromes (18%), oropharyngeal malformations (8%), metabolic diseases (6%), cystic fibrosis (5%), prematurity (4%), and other less frequent (5%).

Table 3. Endoscopy findings of diagnostic upper gastrointestinal endoscopy (UGE)

Result*	n = 227 Frequency (%)
Gastropathy	70 (31)
Esophagitis	47 (21)
Normal	40 (17)
Duodenopathy	14 (6)
Caustic esophagitis	11 (5)
Gastric ulcer	8 (4)
Hiatal hernia	8 (4)
Duodenal ulcer	7 (3)
Esophageal varices	7 (3)
Eosinophilic esophagitis	5 (2)
Others**	10 (4)

*An UGE may have more than one abnormal finding. **Achalasia, eccentric pylorus, Mallory Weiss syndrome, duodenal atresia, duodenogastric reflux, intestinal lymphangiectasia.

Table 4. Therapeutic indications for upper gastrointestinal endoscopy (UGE)

Indication	Frequency (%)
Percutaneous endoscopic gastrostomy	157 (43)
Foreign body ingestion	103 (28)
Refractory esophageal strictures	90 (24)
Esophageal varices	18 (5)

The predominant age group was preschoolers (57%), followed by older infants (18%). Regarding the sex ratio, it was 1:1. Coins accounted for 76% of the objects found, followed by food (8%), and flat batteries (5%). Table 4 describes the therapeutic indications for performing UGE.

Therapeutic interventions were performed in 12 of the UGE indicated as diagnostic, accounting for 380 interventions. These procedures were nasojejunal tube placement, polypectomy, adrenaline injection, and parasite removal.

30 patients had a history of congenital esophageal atresia corrected with anastomotic stenosis. 90% of these patients underwent mechanical dilation with Savary-Gilliard bougies and the remaining patients underwent pneumatic balloon dilatation. 20% required local infiltration with steroids (triamcinolone).

Besides, 23 patients had caustic ingestion, and most of them were under 5 years of age (95%). 8 patients developed secondary esophageal stricture and, of these, six had recurrent strictures requiring frequent esophageal dilations, and four of them needed placement of a silicon-coated nitinol stent. Esophageal dilations due to stricture secondary to caustic ingestion accounted for 10% of the total number of therapeutic interventions.

Complications

Procedure-related complications occurred in 0.5% of interventions, corresponding to significant active bleeding that prevented the initially planned therapeutic intervention in a patient with esophageal stricture at the site of anastomosis due to esophageal atresia, one case of subcutaneous emphysema due to esophageal perforation in a patient with a history of esophageal stricture due to caustic ingestion, and one case of pneumoperitoneum in a patient with esophageal stricture secondary to esophageal atresia.

All procedures were performed under general anesthesia. Complications related to the anesthetic process occurred in 0.7%, one patient had severe bronchospasm, another had glottic edema, one had accidental extubation requiring cardiopulmonary resuscitation, and the last one developed pulmonary hemorrhage. All patients had comorbidities.

There were no procedure-related or anesthesia-related deaths.

Discussion

This study describes an important cohort of patients compared with previous publications, with a sig-

nificant percentage of therapeutic UGEs, including the performance of PEG in neonatal patients, a procedure that is performed in a few institutions in our region due to the limited availability of equipment.

In our analysis, we found that 100% of the procedures were pertinent according to the indications of the ESGE/ESPGHAN guidelines which agree with that described by Altamimi et al. and Lee et al. who reported 86% and 99% of pertinence for UGE, respectively[3,8]. The high relevance rate of performing UGE in the institution is related to the indication of the procedures by specialists in digestive tract pathologies.

In our study, the most frequent indications are described as follows:

Abdominal pain

We found that, of the total number of diagnostic UGEs, the highest percentage was performed due to this cause, which is consistent with the findings of Altamimi et al. in a study in Jordan, where abdominal pain accounts for 45% of the UGEs[8]. Another study that included 1000 patients found that abdominal pain was the indication for UGE in more than one-third of the cases[4], very similar to our results.

In a study in Cali, that included 37 patients who underwent UGE due to chronic abdominal pain, they found that 80% of the patients had abnormal macroscopic findings and of these 70% corresponded to gastritis[9], which agrees with our findings. Wang et al. found that only 34% of patients with abdominal pain had a macroscopic abnormality on UGE[10], in contrast to our study, possibly explained by the fact that most of the UGEs in that study were indicated by pediatrics.

Upper gastrointestinal bleeding

The findings in our study agree with those reported in a study in Tokyo, where 50% of the patients had a gastric or duodenal ulcer, which occurs predominantly in males[11], and in Honduras where 56% of the patients with HSVF had erosive gastropathy[12]. In our study and the two previously mentioned, the most affected age group was adolescents; this could be related to dietary habits, alcohol consumption, and stress management.

Percutaneous endoscopic gastrostomy

In our study, PEG was the main indication for therapeutic UGE. The ESPGHAN, in its latest publication on PEG, describes that the most frequent indication in pediatrics is neurological disorders[7], similar to what we found in this study, and which agrees with what was reported in a study that included 39 patients, where neurological diseases motivated the indication of 73% of the PEGs[13]. These patients have alterations in the suck-and-swallow mechanism or oropharyngeal dysphagia; therefore, the performance of PEG allows patients to have a significant improvement regarding nutritional parameters[14].

Other indications found in our study were genetic disorders, metabolic diseases, oropharyngeal malformations, cystic fibrosis, heart disease, and prematurity, similar to that described in other pediatric studies[15,16]. These pathologies cause an increase in energy expenditure due to the high catabolic state of the patients, and in which PEG can help to improve their nutritional status[17].

In this study, 51% of the patients were less than 12 months old, the youngest patient was 23 days old and weighed 3 kg. Alhaffaf et al. describe in their study that 31% of the patients were less than 2 years old and the smallest patient weighed 3.5 kg and was 5 months old[13].

Foreign body ingestion

It is a common problem in the pediatric population, it can occur at any age, but it is more frequent between six months and six years[18], similar to what was found in our study, which is explained by the curiosity of children to explore the world, and, in this process, they put objects in their mouths and may ingest them accidentally. Gatto A. et al. found that the most affected age group is children between one and two years of age with 40%[19], different from our findings where the highest percentage of cases occurred between two and five years of age.

Coins are the most frequently ingested foreign body in the pediatric population, in up to 30% of the cases there can be spontaneous elimination and the probability of impaction is related to an age of fewer than 5 years and a coin size greater than 23.5 mm[20], as evidenced in our study which is related to the fact that Colombian coins greater than 200 pesos comply with the size characteristic. The finding of coins as the main foreign body found agrees with what has been reported in other studies[21,22]. The second most frequent foreign body was food followed by flat batteries, similar to that described by Khorana J. and contrary to that reported by Al Lawati, where the second most frequent object was flat batteries[21,23]. Over the years, there has been an increase in the percentage of patients who ingest flat batteries, related to the greater diameter and availability of these in the home, given the risk of impaction with secondary esophageal mucosal injury, being this one of the main causes for performing a UGE[20]. It is necessary to strengthen preventive measures to avoid this type of accident at home.

Esophageal dilation

Endoscopic esophageal dilations were the third most performed procedure. The main dilation technique was the Savary-Gilliard bougies (90%), different from that reported by Ghiselli A. et al. in a review that

included 738 patients and where the main technique was the use of a balloon[24]. There are no studies that demonstrate the superiority of one technique over the other, both techniques can be used safely, and with a similar frequency of complications[25].

Accidental caustic ingestion is a public health problem and is the most common cause of esophageal stricture in children, with the subsequent need for esophageal dilation to ensure patency of the upper gastrointestinal tract[26]. In our study, 95% of the patients who presented caustic ingestion were under five years of age and 33% of them developed esophageal stenosis, similar to what is described in the literature where preschoolers are the most affected and the appearance of stenosis occurs between 2% and 49% of the cases[26,27]. These patients require frequent endoscopic dilations, with success rates between 58% to 96%, and in refractory cases, other therapeutic measures can be performed such as stent placement, which is a technique widely used in the adult population, both in benign and malignant pathology and which has been extrapolated to the pediatric population with favorable results[26,28] as evidenced in this study.

Complications

During the performance of UGE, complications such as perforation and bleeding may occur[3], which are infrequent when performed by trained professionals, and, when they do occur, they are mainly related to therapeutic procedures and in patients with preexisting medical conditions[29], similar to our findings. Shrestha S. et al. and Attard TM. et al. reported a complication rate of 0.7% in therapeutic procedures[29,30]. The anesthetic complication rate is < 2% and patients with comorbidities are at the highest risk[31], which is consistent with our study population in both the rate of presentation and the clinical characteristics of affected patients.

This study has some limitations. It was performed in a referral center which may represent selection bias due to the complexity of the patients, it was not possible to evaluate the relevance of the indication by the pediatrician since no UGE was ordered by this specialty by institutional protocol, and the histopathological results were not included which could overestimate the normal results.

In conclusion, with the data found in this study, such as the low rate of complications related to both the procedure and anesthesia, in addition to the high diagnostic and therapeutic performance, we can conclude that UGE is an effective and safe tool in pediatric patients. An important percentage of therapeutic UGE could be avoided from primary prevention since they correspond to accidents at home due to foreign body ingestion or caustic poisoning.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

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