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ORIGINAL ARTICLE

Percutaneous endoscopic gastrostomy in pediatric patients

Gastrostomía percutánea endoscópica en pacientes pediátricos

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

Percutaneous endoscopic gastrostomy (PEG) is a safe and effective technique that has been used in patients requiring long-term nutritional support. In the pediatric population, evidence on this procedure, its complications, and outcomes is limited in some regions of Latin America, making it necessary to conduct more observational studies to evaluate its safety over time.

What does this study contribute to what is already known?

This retrospective study shows the experience of PEG in a high-complexity hospital. It confirms that PEG in pediatric patients is a safe procedure for establishing the enteral route, even in critically ill patients, demonstrating a low frequency of complications and no associated mortality.

Abstract

Percutaneous endoscopic gastrostomy (PEG) is the method of choice for gastrostomy placement in children. However, variable incidence rates of complications have been reported. **Objective:** To report our experience with PEG tube insertion using the traction technique in pediatric patients in the gastroenterology department of a tertiary care hospital in Colombia. **Patients and Method**: Retrospective study of PEGs performed in a group of pediatric patients, aged 1 to 17 years, between August 2015 and January 2024. Demographic characteristics, final condition at the time of hospitalization, and associated complications were recorded. **Results:** A total of 56 PEG tubes were placed in patients; 69.6% were male. Most patients had a pre-existing medical condition. Moderate to severe neurological sequelae and secondary swallowing disorders that prevented oral intake were the main reasons for PEG placement (44,7%), followed by congenital diseases (23,2%). Five patients in the study group (8.9%) experienced late complications, requiring replacement of the gastrostomy tube due to deterioration of the feeding equipment and the placement of a transgastric-jejunal feeding tube. There were no deaths related to the procedure. **Conclusions:** PEG in pediatric patients is a safe way to establish an enteral route, even in critically ill patients, demonstrating a low frequency of complications and with no associated mortality.

Keywords:
Gastrostomy;
Gastrointestinal Endoscopy;
Swallowing Disorders;
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Introduction

Gastrostomy is the preferred route for long-term administration of nutrition and/or medications in patients with swallowing disorders, some with musculoskeletal deformities and neurological disorders[3,4]. This procedure has been performed since the mid-20th century in adults, in most cases without the need for an operating room[5], and since 1980, its use in the pediatric population has been described[6]. Currently, the techniques used to perform gastrostomy can be laparoscopic, laparotomy, percutaneous endoscopic, radiologically guided percutaneous, and a combination of laparoscopic and endoscopic[7]. The main indications for PEG include structural and/or mechanical alterations of the digestive tract, impaired consciousness, head and neck tumors, and neurological diseases. However, it can also be useful in cases of gastric decompression, bile reinfusion, extensive facial trauma, and gastric volvulus[8]. PEG arose from the need to provide comprehensive nutritional support to compensate for the body's requirements when these cannot be met through daily oral food intake. In general, it is intended for patients who require enteral nutrition for more than 8 weeks, assuming that the gastrointestinal tract is functioning properly[9].

Despite being a widely accepted procedure, there are few Latin American studies in the pediatric population using endoscopic techniques, which can be performed under sedation, unlike open and/or laparoscopic surgical techniques, which require general anesthesia and must be performed in operating rooms with the inherent risks associated with them[7]. There are two techniques for gastrostomy tube placement: pull or push, the former being the safest in the pediatric population[8,10].

The objective of this research was to describe the demographic characteristics, triggering diseases, and complications secondary to PEG in users under 18 years of age at a high-complexity center in Colombia between August 2015 and January 2024.

Patients and Method

Study design

A retrospective study was conducted using electronic clinical records of PEGs performed by the gastroenterology service in endoscopy rooms or in the pediatric intensive care unit at *Hospital San Rafael de Tunja*, a high-complexity institution and referral center for three departments.

Patients

All pediatric patients (aged 1 to 17 years) who underwent PEG by the gastroenterology service between August 2015 and January 2024 with associated diagnoses of swallowing disorders or aspiration pneumonia were included. Patients with surgical gastrostomy, PEGs performed at another institution, and incomplete medical records were excluded. The electronic medical records of the patients of interest were reviewed, and demographic characteristics, acute illness and/or underlying disease, presence of associated complications, final condition at the time of hospitalization, and follow-up for up to 2 years after the procedure were described.

Surgical technique

As part of the initial protocol for the percutaneous and endoscopic procedure, asepsis and antisepsis of the anterior abdominal wall and oral cavity were performed with chlorhexidine and/or povidone-iodine. Additionally, prophylactic antibiotics were administered, except in patients who were already receiving antibiotics due to their underlying pathology requiring hospitalization. All PEGs were performed using the pull-through technique, with 16-20 Fr tubes inserted via a flexible endoscope through the oral cavity into the stomach. Subsequently, under direct endoscopic visualization, a transillumination point was identified on the anterior abdominal wall, and puncture of the skin and abdominal wall was performed until entry into the gastric cavity, which was confirmed by endoscopic visualization (Figure 1a). A metal guidewire was inserted through the needle, retrieved with an endoscopic snare (Figure 1b), and exteriorized through the mouth. The gastrostomy tube was then mounted over the guidewire and pulled until it was positioned within the gastric cavity, with endoscopic verification to ensure that the internal bumper ("mushroom") was not causing gastric mucosa ischemia. Tube patency was confirmed by water instillation (Figure 1c), with the internal bumper adjusted against the gastric wall. The external end was brought out through the abdominal wall and secured with an external retention device (Figure 1d).

Statistics

Statistical analysis was performed using SPSS (version 25.0)[11]. For qualitative variables, frequency measures were used, accompanied by their respective 95% confidence intervals, while quantitative variables were analyzed using the Kolmogorov-Smirnov normality test, considering a $p < 0.05$, and measures of central tendency and dispersion were calculated according to their normality. Tests were used to compare independent groups for mortality and complication outcomes according to age using the Chi^2 test; in cases where low expected values were identified in any cell, Fisher's exact test was used. The correlation

between mortality at discharge and clinically important variables such as patient age and the presence of complications was defined using Spearman's correlation coefficient.

Ethical considerations

Before all procedures, legal guardians were informed of the risks and benefits, and written informed consent was obtained in compliance with Law 23 of 1981, Article 16 of the Political Constitution of Colombia[12], and Resolution 068 of 2018 of *Hospital San Rafael de Tunja*[13]. This research protocol followed the principles established in the Declaration of Helsinki[14] and Resolution 8430 of the Colombian Ministry of Health[15], in which this type of study is considered risk-free research. Given the lack of intervention or modification, informed consent from the guardian was not required, and it was approved by the research and bioethics committee of the *Hospital Universitario San Rafael de Tunja* through minutes 006-2023.

Results

56 PEGs were performed in pediatric patients; there were 39 males (69.6%) and 17 females (30.4%), with a minimum age of 1 year, a maximum age of 17 years, and a median age of 13 years (IQR 6-16).

A record of pre-existing pathologies was kept in the patients who underwent surgery, and it was observed that only in 11 cases was there no record of previous pathology. Moderate to severe neurological sequelae, along with severe secondary swallowing disorders, were identified as the main reasons why this group required artificial nutrition, followed by congenital diseases (Table 1), with the entire population receiving a minimum of 4 weeks of enteral nutrition before the procedure. Among the most frequent neurological disorders, cerebral palsy was the most common, followed by sequelae from meningitis in 18.2%. In terms of genetic diseases, the most common was mucopolysaccharidosis, of all cases, in addition to

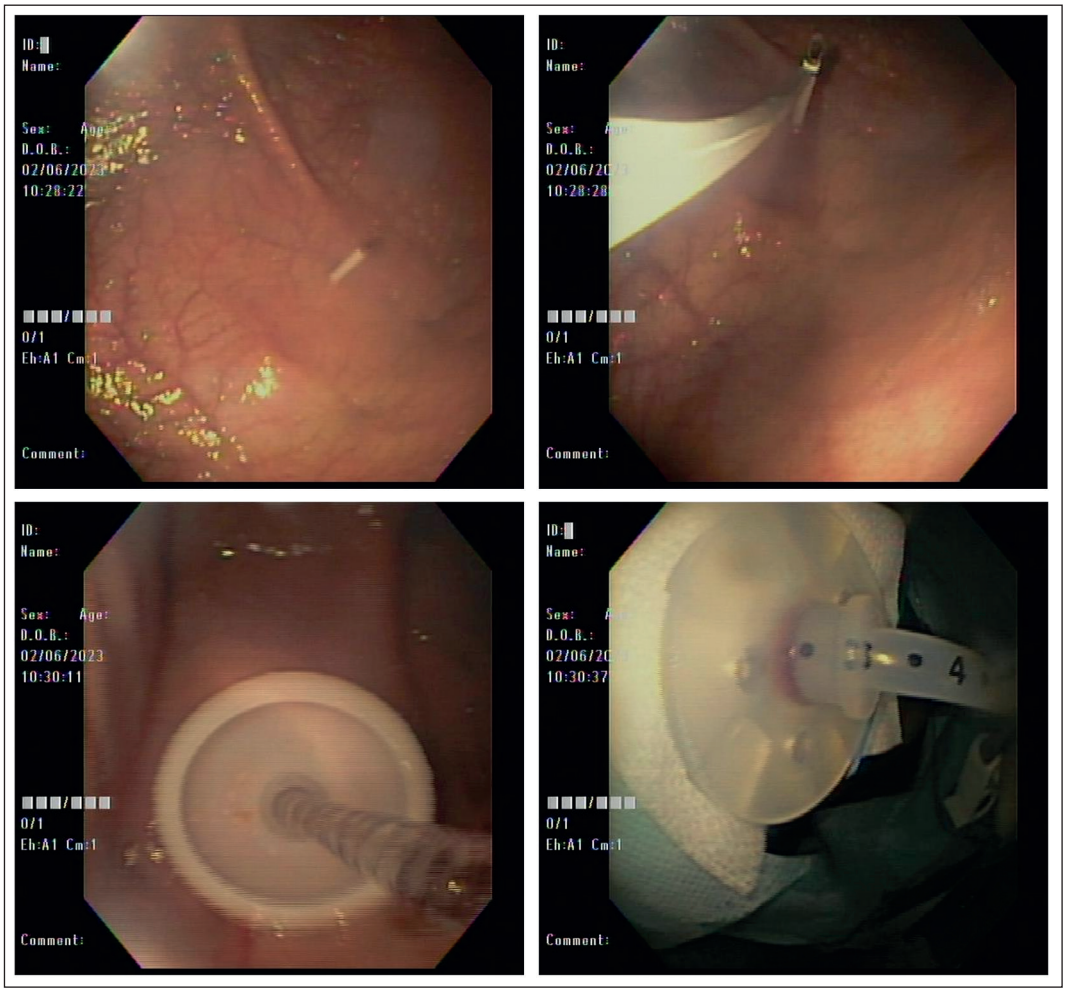

Figure 1. PEG surgical technique. **a.** Punction; **b.** Capture; **c.** Functional gastrostomy; **d.** External bumper.

type A hemophilia and brain arteriovenous malformation. In addition, those secondary to severe traumatic brain injury were the main cause of trauma-related cases, followed by attempted suicide (hanging) (Table 1).

Table 2 describes the diseases that led to admission to the hospital, with respiratory tract infections and decompensation of the underlying disease being the most frequent reasons for hospitalization. However, traumatic injuries or their sequelae accounted for 21.1% of cases requiring a PEG. During the study period, four patients were rehospitalized for reasons unrelated to PEG care, while five additional patients (8.9%) were rehospitalized specifically for the management of late complications. Two of these patients required gastrostomy replacement due to deterioration of the artificial feeding tube, and three patients developed major complications requiring placement of a transgastric-jejunal enteral feeding tube as part of the management plan for pneumonia secondary to gastroesophageal reflux. There were no periostomal infections or button-related complications.

PEGs were performed during hospitalization in 100% of patients. Table 3 describes the antibiotics and/or antivirals for the infectious diseases that led to hospitalization.

Mortality was assessed at the end of the hospital stay, finding that 16% of patients died from causes unrelated to the PEG procedure. This outcome was determined by the pathology that led to hospitalization, such as infectious processes, cerebral edema, and deterioration due to congenital disease. Deaths occurred more than 72 hours after the procedure. There was no correlation between patient age and mortality at the end of the stay (Spearman 0.2, $p = 0.14$). However, there was a correlation between leukocytosis on admission and the presence of any complications with the desired outcome (Spearman 0.57, $p < 0.05$; Spearman 0.27, $p = 0.04$) (Table 4).

Patients were in follow-up for up to 2 years after discharge, either in the outpatient setting or in the emergency department, depending on their clinical presentation. The following events were observed: in one patient, accidental removal of the gastrostomy tube at 6 months, which was managed by placing a balloon tube through the same tract; in another patient, gastrostomy removal due to swallowing recovery; and in three patients, change to a post-pyloric transgastric tube due to gastric emptying disorder.

Table 1. Baseline disease

Baseline disease	Frequency	Percentage
Neurological Sequelae	25	44,7
Cerebral palsy	12	21,4
Meningitis sequelae	4	7,1
Hypoxic encephalopathy	3	5,4
Kernicterus	1	1,8
Herpes encephalitis sequelae	2	3,6
Acute temporal cerebrovascular accident	1	1,8
Craniopharyngioma resection sequelae	1	1,8
Epileptic neurodegenerative encephalopathy	1	1,8
Congenital Disease	13	23,2
Mucopolysaccharidosis	3	5,3
X-linked adrenoleukodystrophy	1	1,8
Duchenne disease	1	1,8
Cachs syndrome	1	1,8
Lennox gastaut syndrome	1	1,8
Down syndrome	1	1,8
Metabolic disease due to gluconeogenesis defect	1	1,8
Hemophilia type A sequelae	1	1,8
Stocco dos Santos syndrome	1	1,8
Dandy Walker syndrome	1	1,8
Cerebral arteriovenous malformation	1	1,8
Secondary to trauma	8	14,2
Severe traumatic brain injury (TBI) sequelae	6	10,7
Hanging sequelae	2	3,5
No history	11	17,8
Total	56	100,0

Source: Own elaboration base on clinical records registry

Table 2. Triggering pathology for hospitalization

Pathology	Frequency	%
Pneumonia	21	36,8
Convulsive status	11	19,3
Suicide attempt	5	8,8
TBI	5	8,8
Intracranial bleeding	3	5,3
Hypoxia sequelae	3	5,3
Spinal cord trauma	2	3,5
Viral encephalitis	2	3,5
Tube dysfunction	2	3,5
Soft tissue infection	1	1,8
Airway obstruction	1	1,8

TBI: Traumatic brain injury.
Source: Own elaboration base on clinical records registry.

Table 3. Antibiotic/antiviral management at the time of gastrostomy

Pharmacological management	Frequency	Percentage
None	28	50,0
Cephalosporins	14	25
Beta-lactamase inhibitors	7	12,5
Cephalosporins + glycopeptide	2	3,5
Acyclovir	1	1,8
Cephalosporins + lincosamides	1	1,8
Polymyxins + glycopeptide	1	1,8
Glycopeptide	1	1,8
Beta-lactam	1	1,8
Total	56	100

Source: Own elaboration base on clinical records registry.

Table 4. Correlation between mortality and clinically relevant variables

Mortality at the end of the hospital stay	Spearman´s rank correlation coefficient	p value
PAFI*	-0.044	0.800
Leukocytosis (> 12 x 103 ul)	0.570	< 0.001
Hemoglobin (> 10 g/dL)	-0.200	0.188
Hematocrit (> 30%)	0.180	0.286
Platelets (> 250000/mcL)	0.203	0.187
Age	0.200	0.140
Sex	0.077	0.571
Presence of complication†	0.276	0.040

*PAFI (PaO2/FiO2 ratio), †Presentation of major or minor complications during the hospital stay. Elevated leukocytosis and clinical complications correlate whit higher in-hospital mortality risk, whereas other parameter like oxygenation (PAFI), hemoglobin, platelets, age and sex showed no statistically significant correlation.

Discussion

PEG is a technique that provides an easy way to feed patients with limited intake, with few complications and low mortality secondary to the procedure[4,16]. The updated review of the ESPGHAN position states that PEG is indicated when prolonged non-oral nutrition (> 3-6 weeks) is anticipated or when nasogastric feeding is not safe[17]. In our study, the male population predominated, with the main indication being difficulty swallowing due to neurological sequelae, results that coincide with the data reported in the world literature[3,6,7,18,19].

Although there are no specific studies on the course of chromosomal disorders towards feeding incapacity in Colombian populations with poor nutrition, the ESPGHAN guideline[17] shows that underlying genetic diseases have a high prevalence of nutritional complications. These observations are consistent with the data obtained in our center, where congenital diseases were the second most common indication. However, these data may be influenced by the fact that we are in a highly complex center that receives patients from three departments, in addition to being an area known for its high frequency of autosomal recessive inheritance pathologies[20,21].

Overall mortality in pediatric patients with PEG is low when attributed to the procedure itself. Catto-Smith et al. reported that, after follow-up between 6 and 14 years in children with neurological disabilities, mortality reached 39% but was not directly related to PEG[22]. The mortality findings in our study are lower than those reported in similar studies[23,24]. This discrepancy may be secondary to the deaths observed were a consequence of underlying pathologies[25], and none were attributable to the procedure itself, which is consistent with what was reported by Hansen[26]. Regarding the population studied, the youngest patients included one-year-old children; however, 23.1% of the cases were adolescents between 11 and 17 years of age, who presented conditions secondary to trauma due to traffic accidents or suicide attempts. This highlights the need to raise awareness of this age group and develop primary prevention or public policies that address these events[27,28], which have not been sufficiently documented in national or international literature.

This study reinforces the safety of the procedure by reporting low complications in this population, consistent with previous studies comparing open and endoscopic gastrostomy techniques[10,23,25]. In addition, it has been observed that PEG avoids the need for laparotomy, reduces surgical time, and decreases postoperative pain[6]. These advantages make it the preferred technique; however, further research is needed to evaluate long-term outcomes.

This study provides solid evidence on the characteristics of patients who require PEG in Colombia. However, further research is essential to validate these findings and explore aspects such as nutritional recovery, secondary gastroesophageal reflux, possible improvements in the technique, and the management of other complications.

The main limitation of this research lies in its retrospective nature and the non-representativeness of the population studied, since, as it is a high-complexity general hospital (non-pediatric) that treats referrals from three departments, it may overestimate the prevalence of congenital pathologies compared to the

general population. The absence of reported periostomal complications could be due to the small size of the population studied. This characteristic may influence the results and applicability in other pediatric populations. In addition, we observed a lack of additional studies in the region or in the country that support or contradict our findings.

Conclusion

PEG in pediatric patients is a safe procedure for reestablishing the enteral route, even in critically ill patients or those on ventilatory support, demonstrating a low frequency of associated complications and mortality. In the study population, the need for enteral nutrition was mostly associated with congenital pathologies with swallowing disorders. In our study, multiple traumas in traffic accidents and suicide attempts with severe neurological sequelae represented a large percentage of our study population, and we therefore suggest increasing educational campaigns, especially to prevent traumatic injuries and suicide attempts. In terms of clinical outcomes, mild to moderate complications were documented in a small number of patients, with no adverse events directly attributable to the procedure, which reinforces its safety profile. In addition, the overall mortality rate recorded (16%) was related exclusively to the underlying pathology, with no evidence of a causal relationship with the gastrostomy itself.

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

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