

# Percutaneous endoscopic gastrostomy in children less than 10 kilograms: A comparative study

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## Abstract

**Background/Aim:** Percutaneous endoscopic gastrostomy tube (PEG) has replaced the standard open surgical gastrostomy for enteral nutrition. However, several complications were reported, especially in children less than 10 kg. Our objective was to report the outcomes of percutaneous endoscopic gastrostomy in children according to their weight.

**Patients and Methods:** 163 children had PEG tube insertion in our tertiary referral hospital from January 2007 to March 2019. Patients were divided into two groups according to the weight; group I (less than 10 kg;  $n = 112$ ) and group II (more than 10 kg;  $n = 51$ ). Comparisons were made between the two groups for incidence of postoperative complications, the need for reintervention, 30-day, and 1-year mortality.

**Results:** There were 51 males (45.5%) in group I and 27 in group II (52.9%) ( $P = 0.38$ ). The mean weight at the time of endoscopy was  $5.9 \pm 1.53$  and  $17.3 \pm 8.23$  kg and the mean American Society of Anesthesiologists (ASA) score was  $2.6 \pm 0.67$  and  $2.43 \pm 0.57$  in group I and II, respectively ( $P = 0.101$ ). The most common associated condition was cerebral palsy (50 (44.6%) and 24 (47.1%) in group I and II, respectively;  $P = 0.77$ ). The mean operative time was  $30.28 \pm 11.57$  min in group I and  $33.62 \pm 23.36$  min in group II ( $P = 0.221$ ). Skin complications were the most commonly encountered complications of PEG, and 49% ( $n = 48$ ) required the removal and replacement of the tube under general anesthesia in group I and 41% ( $n = 21$ ) in group II ( $P = 0.84$ ). There was no significant difference in the complication between groups.

**Conclusion:** PEG is a safe technique in children less than 10 kg, and the complications rate is comparable with older children. The use of positive transillumination and small needle for measuring the distance between the skin and the stomach enhances the safety of the procedure. PEG should be considered in children less than 10 kg who need supportive or continuous enteral nutrition for different reasons.

**Keywords:** Complications, indications, percutaneous gastrostomy tube

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**Submitted:** 15-Oct-2019 **Revised:** 28-Nov-2019 **Accepted:** 03-Jan-2020 **Published:** 03-Feb-2020

## INTRODUCTION

Nasogastric tube feeding has several limitations precluding its use as a long-term enteral tube feeding, and it was

associated with decreased survival rates.<sup>[1]</sup> The primary goal of a gastrostomy tube is to prevent malnutrition and provide medications with proper compliance.<sup>[2]</sup> The gastrostomy tube is used if enteral feeding is required for

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Quick Response Code:	Website: www.saudijgastro.com
	DOI: 10.4103/sjg.SJG_525_19

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**How to cite this article:** Bawazir OA. Percutaneous endoscopic gastrostomy in children less than 10 kilograms: A comparative study. Saudi J Gastroenterol 2020;26:105-10.

a period longer than 2 or 3 weeks.<sup>[3]</sup> Several conditions affecting swallowing and those that impair feeding warrant the use of a gastrostomy in children.<sup>[4]</sup>

Percutaneous endoscopic gastrostomy (PEG) tube placement is a less invasive alternative to standard open surgical gastrostomy insertion.<sup>[5-7]</sup> PEG has gained popularity as a minimally invasive procedure with low cost and better patient tolerability.<sup>[8]</sup> However, PEG has complications, including both minor and major ones. It is thought that the complications of PEG increase if used in low weight children. Therefore, the objectives of the study were to assess the indications and complications of percutaneous endoscopic gastrostomy in children weighing less than 10 kg and compare them to children weighing more than 10 kg.

## PATIENTS AND METHODS

### Study design and patients

This research is a retrospective cohort study that included pediatric patients who had PEG tube insertion from January 2007 to February 2019 at King Faisal Specialist Hospital and

Research Center, Jeddah, Saudi Arabia. The IRB-approval was obtained before data collection (Ref: RC-J/392/39 on May 2018), and parents' consent was waived due to the retrospective nature of the study. Patients were divided into two groups; group I included children who had PEG, and their weight was less than 10 kg ( $n = 112$ ), and group II included children who weighed more than 10 kg at the time of PEG insertion ( $n = 51$ ). The age, weight, indications, and the complications during and after PEG tube insertion were reviewed. The position of PEG was confirmed by positive transillumination through the stomach and abdominal wall. Patients who had a history of upper abdominal surgery before PEG insertion, patients with pure esophageal atresia, and too small baby less than 2 kg in weight were excluded. The study flowchart is shown in Figure 1.

### Study endpoints

A comparison was made between both groups as regards preoperative baseline data, concomitant conditions, and operative time. Study endpoints were the postoperative complications, the need for reintervention, 30-day, and 1-year mortality.

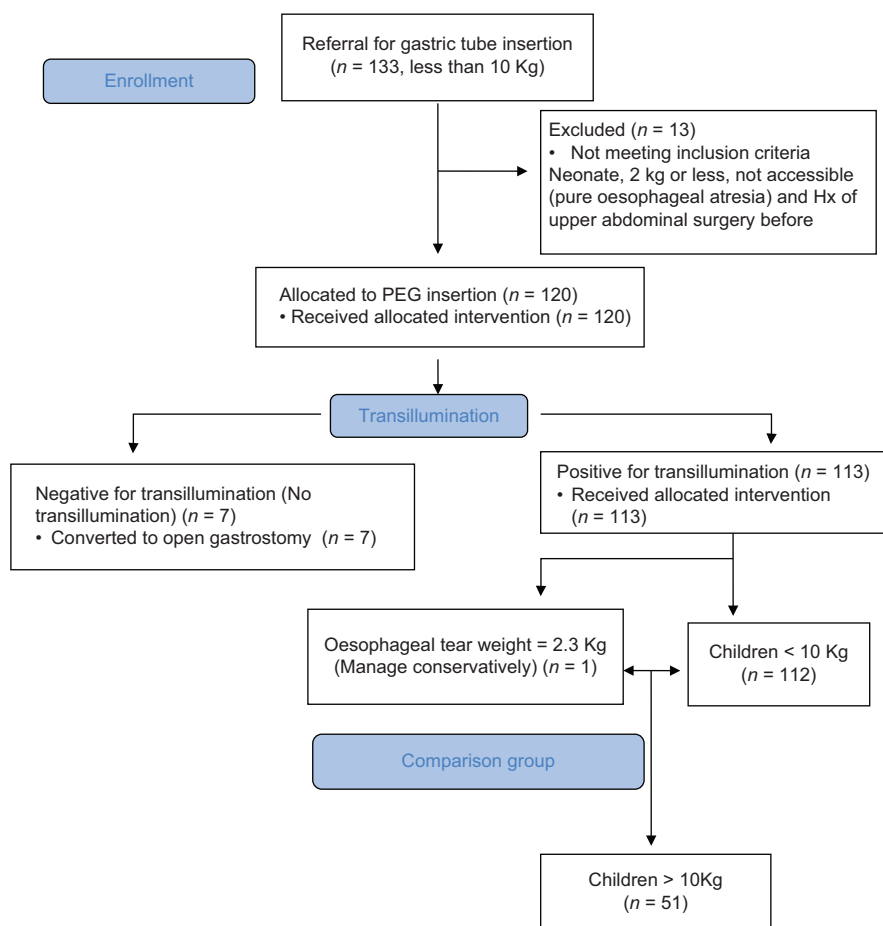


Figure 1: The study flowchart

## Gastrostomy technique

Preoperative cefazolin was given before the procedure in all patients. Feeding and medications were commenced within one day after the gastrostomy tube's (GT) insertion. The insertion was performed through the "pull" technique<sup>[9]</sup> under general anesthesia. A 6 mm pediatric upper endoscope to decrease tracheal compression was used. Additionally, we minimized the period of gastric insufflation to prevent bowel distension. We insufflated the stomach with air to displace any organs anteriorly. Then transillumination was used to determine the gastrostomy site; a 25G needle was used to check the distance between the skin and the stomach mucosa. The pediatric surgeon placed a 14 French Kimberly Clark Professional PEG Pull Kit (Kimberly Clark, Allen, Texas, USA) using the pull technique, then we confirmed the final position of the PEG with gastroscopy. At the three to six-month follow-up visit, we used to remove the PEG in the clinic, especially in older patients with cerebral palsy; this practice has stopped. Now, the surgeon replaced PEG tubes with a low profile button device in the endoscopy suite, and in case of any concern regarding the function of the GT tube, a fluoroscopic study was obtained to confirm the position of the button G-tube.

## Statistical analysis

Categorical variables were presented as frequency and percentage and continuous variables as mean and standard deviation. Fisher exact test and Pearson X2 tests were used to compare categorical variables when appropriate. For continuous variables, the student's *t*-test was used for comparison. *P* values < 0.05 were considered statistically significant. Analyses were performed with the SPSS 23 software package (SPSS Inc, Chicago, IL, USA).

## RESULTS

One hundred thirty-three children weighing less than 10 kg were referred to our service for gastrostomy tube insertion. Thirteen patients were excluded [Figure 1]. Out of the 120 who underwent endoscopy for PEG insertion, seven children were excluded because we could not transilluminate through the abdominal wall.

**Table 1: Preoperative baseline parameters between the two groups**

	Group I (n=112)	Group II (n=51)	P
Age (months)	21.56±29.63	84.9±50.9	<0.001
Male	51 (45.5%)	27 (52.9%)	0.38
Weight (kg)	5.9±1.53	17.3±8.23	<0.001
ASA	2.6±0.67	2.43±0.57	0.19

Continuous variables are presented as mean±standard deviation and categorical variables as number and percent. ASA: American Society of Anesthesia Score

**Table 2: Concomitant preoperative conditions**

	Group I (n=112)	Group II (n=51)	P
Cerebral palsy	50 (44.6%)	24 (47.1%)	0.77
Congenital muscular dystrophy	4 (3.6%)	3 (5.9%)	0.68
Metabolic disease	13 (11.8%)	6 (11.6%)	>0.99
Mitochondrial disease	1 (0.9%)	1 (2%)	0.53
Renal disease	12 (10.7%)	6 (11%)	0.80
VP shunt	3 (2.7%)	1 (2%)	0.78
Cardiac disease	18 (16.1%)	6 (11.7%)	0.63

Continuous variables are presented as mean±standard deviation and categorical variables as number and percent. VP: Ventriculo-peritoneal

One child with a weight of 2.3 kg had a lower esophageal perforation, which was recognized during the procedure, and PEG insertion was aborted. A nasogastric tube was inserted, and antibiotic started, and the infant was managed conservatively. The upper GI contrast study showed completely healed esophagus after ten days.

One-hundred twelve patients less than 10 kg were included (group I) and compared to 51 patients weighing more than 10 kg (group II). There were 51 (45.5%) males in group I and 27 (52.9%) in group II (*P* = 0.38). Mean weight at endoscopy was 5.9 ± 1.53 and 17.3 ± 8.23 kg in group I and II, respectively. The mean American Society of Anesthesiologists (ASA) score was 2.6 ± 0.67 and 2.43 ± 0.57 in groups I and II, respectively (*P* = 0.101) [Table 1].

The most common associated condition was cerebral palsy (50 patients [44.6%] and 24 [47.1%] in group I and II, respectively, *P* = 0.77). Twelve patients had a concomitant renal disease (10.7%) in group I versus 6 (11%) in group II, and 3 (2.7%) vs. 1 (2%) had ventriculoperitoneal (VP) shunt in group I and II, respectively. There was no difference between groups as regards to the associated conditions [Table 2].

The mean operative time was 30.28 ± 11.57 min in group I and 33.62 ± 23.36 min in group II (*P* = 0.221). There was no difference between groups in the complications rate. Skin (granulation or erosion) complications were the most commonly encountered complications of PEG, and 49% (*n* = 48) required the removal and replacement of the

**Table 3: Postoperative complications**

	Group I (n=112)	Group II (n=51)	P
Operative time (min)	30.28±11.59	33.62±23.36	0.22
Late tube dislocation (after 6 months)	3/108 (2.7%)	2/49 (4%)	0.65
Granulation	13 (11.6%)	9 (17.6%)	0.63
Pneumonia	19 (17%)	8 (15.7%)	0.84
Vomiting	20 (17.9%)	7 (13.7%)	0.65
Skin erosion	11 (9.8%)	6 (11.8%)	0.78
Dislodgement	10 (8.9%)	3 (5.9%)	0.75

Continuous variables are presented as mean±standard deviation and categorical variables as number and percent

**Table 4: The number and indications for reinterventions**

	Group I (n=112)	Group II (n=51)	P
Removal/replacement	48 (42.9%)	21 (41.2%)	0.84
Fundoplication	9 (8%)	3 (5.9%)	0.71
Exploration for pneumoperitoneum or dislodgment	1 (0.9%)	1 (1.9%)	0.53

Continuous variables are presented as mean±standard deviation and categorical variables as number and percent

tube under general anesthesia in group I and 41% ( $n = 21$ ) in group II ( $P = 0.84$ ) [Table 3].

30-day mortality was 4 (3.6%) in group I and 2 (3.9%) in group II ( $P > 0.99$ ), and 1-year mortality was 10 (8.9%) vs. 2 (3.9%) in group I and II, respectively ( $P = 0.34$ ). There was no difference in the re-intervention rate between the groups [Table 4].

There were 60 patients in group I under 1 year and 52 above 1 year. There was no difference between both subgroups regarding minor complications ( $P = 0.135$ ), major complications ( $P = 0.09$ ), and need for further surgery ( $P = 0.67$ ).

## DISCUSSION

When nutritional support is required for more than 3 months, a gastrostomy tube is the preferred option over nasogastric tube feeding. PEG became the preferred technique as it was associated with reduced morbidity, mortality, and costs, when compared to surgical gastrostomy. Additionally, PEG was associated with lower choking and aspiration episodes, and chest infections.<sup>[10]</sup>

The introduction of less invasive gastrostomy had improved the ability to optimize nutrition in medically complex infants and children.<sup>[9]</sup> Several complications of PEG have been reported in the literature.<sup>[11]</sup> Because of the frequent complications reported with PEG, several modifications of the technique were adopted. The major modification was to position the tube under direct visual control and perform gastropexy.<sup>[12,13]</sup> Laparoscopic techniques were developed either as assisted techniques or fully laparoscopic with lower complications rate.<sup>[14,15]</sup> Recent literature suggests that laparoscopic gastrostomy is a safer approach than PEG.<sup>[16-19]</sup> However, the published series are of small size, and patients' characteristics are different; therefore, PEG remains the common and gold standard procedure.

In our experience, neuro disability and prolonged poor feeding were the main indications for PEG insertion. This was matching with the large series published worldwide.<sup>[11,20]</sup>

Complications are generally divided into major and minor.<sup>[21]</sup> Major complications include hemorrhage, hematoma, organ injuries, gastrocolic fistula, peritonitis, and buried bumper syndrome.<sup>[22]</sup> Minor complications include peristomal infections, leakage, and granuloma.

Children's weight of less than 10 kg is no longer considered contraindications to PEG placement.<sup>[23]</sup> In the present study, patients weighing less than 10 kg were compared to those weighing more than 10 kg. Patients had comparable concomitant conditions, and the outcome was similar. Complication rate was not higher in lower weight children.

Other studies showed that this technique could also be used safely in infants below one year with bodyweight as low as 2.6 kg.<sup>[24]</sup> In a report by Minar *et al.* on PEG in 38 infants, an esophageal tear and secondary pneumoperitoneum were reported.<sup>[25]</sup> The youngest infant in our study was five months old and had a bodyweight of 2.3 kg. Esophageal perforation developed in this patient and was treated conservatively. The PEG tube was used for feeding after seven days after contrast swallow documented healing of the perforation. We recommend size 14 French PEG tube for insertion in body weight of 3 kg or more.

Several other major complications were reported, including leaking with a widening of the stoma, which occurred mainly in severely malnourished children. Several techniques were used to manage leakage, including increasing the size of the tube and decreasing the volume of the feed, to even nil by mouth and total parenteral nutrition. We found best results in removing the gastric tube and letting the gastrostomy site close completely and reinserting another one 6 weeks later.

There is little evidence indicating that PEG increases gastroesophageal reflux,<sup>[26]</sup> and its effect on previously present reflux is unclear.<sup>[6]</sup> The increased frequency of gastroesophageal reflux disease (GERD) could occur because of an associated neurological disease.<sup>[27]</sup> The reported effect of PEG on the present GERD is inconsistent,<sup>[28-30]</sup> and a study recommended that anti-reflux measures should be avoided in those patients, and no investigations are warranted in asymptomatic patients.<sup>[29]</sup> Our patients were not investigated for possible GERD before PEG insertion if there was no complaint of GERD. Vomiting was reported in 18% and 14% of the patients in groups I and II, respectively, and 8% and 6% required fundoplication at a later stage in groups I and II, respectively. This high incidence of vomiting and fundoplication can be explained by the high prevalence of the neurological disease in our cohort; additionally, we did not investigate these patients for GERD prior to

PEG insertion, especially the 50% of patients who were neurologically affected. Therefore, we recommend for GERD workup before PEG insertion.

PEG tubes were inserted in children who had a renal impairment and required gastrostomy for nutritional support and medication ( $n = 12$ ; 10.7%). PEG tube was inserted in children with peritoneal dialysis (PD) catheter, two patients had PEG at the same time as the PD catheter, and one after the PD catheter was used. Special precautions were done, and perioperative antibiotics and antifungal were given, and PD dialysis was stopped for 2 weeks.

Patients with hydrocephalus and VP shunt placement should not be considered unfit for PEG insertion.<sup>[31]</sup> PEG was inserted in 3 (2.7%) children with VP shunt in group I and 1 (2%) patient in group II. No infectious complications were reported, and both children were covered with antibiotics for one week.

Tube dislodgement was not different between both groups, and the rate of dislodgement was comparable with other studies. McSweeney *et al.* in their research on 138 patients who underwent PEG insertion found that the rate of dislodgement was 0.72%.<sup>[32]</sup> Rosenberger *et al.*, in their retrospective study on 563 patients who had PEG, described early dislodgement within the first 7 days in 4.1% of the patients, and total accidental dislodgement in 12.8% with a marked increase in the cost of healthcare.<sup>[33]</sup>

A major limitation of this study is its retrospective nature with its inherent selection and referral biases. Additionally, there's no comparison group to compare the outcomes between PEG and open surgical gastrostomy. Lack of comparison group is attributed to the performance of PEG in all patients since it is the standard of care. However, the study compared the outcome between patients weighing less or more than 10 kg, and the results showed the safety of the technique in children weighing less than 10 kg.

## CONCLUSION

PEG is a safe technique in children with infrequent complications. The use of positive transillumination and small needle for measuring the distance between the skin and the stomach enhances the safety of the procedure. PEG should be considered in children who need supportive or continuous enteral nutrition for different reasons, and low weight is not a contraindication for insertion.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have

given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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