Original Article

# Comparing Various Methods of Treatment for Fecal Impaction in Functional Constipation of Children

**Ghaith Wadhah Hamdoon, Bassam Kalid Al-Hajjar[1], Aws Hazim Al-Numan**

Pediatrics Department, Collage of Medicine, University of Mosul, Mosul, Iraq, [1]Surgical Department, University of Mosul, Mosul, Iraq

## Abstract

**Background:** Functional constipation represents the unusual passage of hard infrequent stool and or painful defecation with no obvious causes and may lead to fecal impaction. Different disimpaction methods are available including oral, rectal, and combined medications. **Objectives:** This study aims to compare the efficacy and effectiveness of different initial disimpaction methods and maintenance therapy for constipation. **Materials and Methods:** It is a prospective single-center non-blinded study. The study was conducted on 105 patients from 1 month to 14 years at pediatrics and surgery clinics at Al-Kansaa Maternity and Children Teaching Hospital from September 2021 to December 2022. The patients were randomized into seven groups [manual disimpaction + phosphate enema, phosphate enema + oral lactulose, phosphate enema + polyethylene glycol (PEG), oral lactulose only, oral PEG only, bisacodyl suppositories + oral PEG, and glycerin suppositories + oral PEG]. The successfully disimpacted patients were randomized into either oral lactulose or oral PEG as maintenance therapy. **Results:** The results revealed that the age was 5 years (66.15%) with a male-to-female ratio of 1.2:1and most of the cases were urban with moderate socioeconomic status. Approximately, 45.15% of patients had symptoms duration between 1 month and 1 year, fecal impaction with soiling was found in 34.32% of them. The highest successful disimpaction rate was in those patients receiving enema + lactulose 16 (16.8%) and the highest unsuccessful responses were in those receiving glycerin suppository followed by PEG (9.5%). Maintenance therapy with either oral PEG or lactulose shows no significant response with a *P* value of 1.000. **Conclusion:** This study concludes that phosphate enema followed by oral lactulose for 7 days was more successful in achieving disimpaction compared with other methods. The results also show that there is no significant result by using either oral lactulose or oral PEG as maintenance therapy.

**Keywords:** Constipation, fecal impaction, oral lactulose

## Introduction

Fecal impaction is defined as an increase in amounts of stool in the rectum and colon. It is usually done by examining a large stool mass and radiograph associated with a history of passing infrequent and large-caliber stools.[1]

The four general steps in bowel retraining:

- Disimpaction (those children who have a large rectal stool mass or fecal incontinence)
- Prolonged pharmacological treatment by laxative with behavioral therapy as a regular evacuation and avoid recurrent constipation
- Dietary changes that encourage the increase of dietary fiber and fluid content to maintain soft stools
- Gradual tapering of laxative then withdrawal as tolerated

Functional constipation may not require any specific testing. A thyroid-stimulating hormone screen for hypothyroidism and Hirschsprung disease should always

**Address for correspondence:** Dr. Ghaith Wadhah Hamdoon, Pediatrics Department, University of Mosul, Mosul 41006, Iraq.
E-mail: gwh@uomosul.edu.iq

**Submission:** 12-Sep-2023 **Accepted:** 23-Jun-2024 **Published:** 30-Apr-2026



**How to cite this article:** Hamdoon GW, Al-Hajjar BK, Al-Numan AH. Comparing various methods of treatment for fecal impaction in functional constipation of children. Med J Babylon 2026;23:498-504.

Access this article online

Quick Response Code:

Website: https://journals.lww.com/mjby

DOI: 10.4103/MJBL.MJBL_1394_23

be considered, especially in young, persistent, or atypical cases. A contrast enema can help with the diagnosis, and referral for a possible biopsy is also an option that will more definitively exclude the diagnosis of Hirschsprung disease.[2]

Disimpaction regimens

- *Oral medications*—for most children, an oral regimen for disimpaction is preferable, especially if the impaction is not severe. Polyethylene glycol (PEG) with or without electrolytes or high-dose mineral oil have all been shown to be effective for initial disimpaction.[3]

Other oral agents that have been used successfully for disimpaction include magnesium hydroxide,[4,5] magnesium citrate,[6] lactulose,[6] sorbitol, senna, and bisacodyl

### *Rectal medications*

*Sodium phosphate enema*—use a 1.13-ounce (33 mL) enema for children 2–<5 years old, a 2.25-ounce (66 mL) enema for children 5–12 years old, and a 4.5-ounce (133 mL) enema for children ≥12 years old.[7]

Bisacodyl suppositories may be of benefit to older children.[7]

- *Oral and rectal medications*—the blend treatment of oral and rectal medications is frequently the most efficient way for moderate or severe fecal impaction. An outpatient rule that combines PEG 3350 (without electrolytes), mineral oil, and sodium phosphate enemas is a preferable approach. In this case, the initial treatment is with oral medication to soften the stool, and rectal medication is added on day 2 to help evacuate the impacted stool.[8,9]

The maintenance regimen for most children comprises daily doses of an osmotic laxative,[1] encouraging assertive treatment with early interference that shown to lead to more rapid recovery.[10-12]

"For Rome IV criteria" at least two of the incidents must include 1 month in children up to 4 years of age:

- Two or fewer defecations per week.
- History of excessive stool retention.
- History of painful or hard bowel movements.
- History of large-diameter stools.
- Presence of a large fecal mass in the rectum of neonates.

In toilet-trained children, the following additional criteria may be used:

- At least one episode per week of incontinence after the acquisition of toilet skills.
- History of large-diameter stools that may obstruct the toilet.

The aim of the study was to compare the efficacy of different methods of disimpaction as initial tools for the treatment of fecal impaction and also to evaluate the effectiveness of various medications in achieving long-term normal soft bowel motions.

## Materials and Methods

This prospective single-center non-blinded, randomized clinical trial was approved by the ethical committee of the College of Medicine University of Mosul, Mosul, Iraq. It was conducted on 105 patients who attended the outpatient pediatrics and pediatric surgery clinics at Al-Kansaa Maternity and Children Teaching Hospital from September 2021 to December 2022, their ages were between 1 month and 14 years, their main complaint was fecal impaction, hard stool, and fecal soiling. Full medical history, including diets, drugs, family, social history, and socioeconomic state, in addition, full clinical examination, including abdominal and rectal examinations were carried out.

Thyroid function tests and celiac screens with tissue transglutaminase-immunoglobulin A (IgA), and IgA levels were performed in selected cases based on clinical suspicion.

A plain abdominal X-ray was performed initially to demonstrate the extent of fecal mass and after disimpaction to evaluate the efficacy of the disimpaction method used in all patients.

### Inclusion criteria

The inclusion criteria include patients in the study who were selected according to the Rome IV criteria for functional constipation.

### Exclusion criteria

Patients with any of the following features were excluded (reference):

1. Constipation in age <1 month.
2. Delayed passage of meconium >48 h after delivery.
3. Family history of Hirschsprung disease.
4. Failure to thrive.
5. Bilious vomiting.
6. Simultaneous urinary retention or incontinence.
7. Fecal incontinence in the absence of rectal impaction.
8. Hypothyroidism.
9. Celiac disease.

The parents of patients who meet the inclusion criteria were informed about the disimpaction plan of management, and their consent was signed.

Disimpaction was done by the oral route, the rectal route, or a combination of the two were compared. There are no randomized studies that compare the

effectiveness of one with the other. The oral approach is not invasive and gives a sense of power to the child, but adherence to the treatment regimen may be a problem.

The patients were randomized into seven groups according to the method of disimpaction used:

1. Digital (manual) disimpaction followed by phosphate enema.
2. Phosphate enema followed by lactulose syrup for 7 days.
3. Phosphate enema followed by oral PEG in maintenance dose for 7 days in children more than 1 year of age.
4. Lactulose syrup only for 7 days.
5. Oral PEG only in children older than 5 years given for 7 days as follows.

Day 1 (4 sachets)–day 2 (6 sachets)–day 3 (8 sachets)–day 4 (10 sachets)–day 5 (12 sachets)–day 6 (12 sachets)–day 7(12 sachets).

6. Bisacodyl suppository (5 mg) followed by oral PEG in maintenance dose for 7 days in children more than 1 year of age.
7. Glycerin suppository (1 g) for infants and glycerin suppository (1.5 g) for older children followed by oral PEG in maintenance dose for 7 days in those older than 1 year.

Phosphate enema (dibasic sodium phosphate 7 g and monobasic sodium phosphate 19 g in 118 mL delivered dose).

PEG (Movicol pediatric 6.9 g sachet powder for oral solution).

Lactulose syrup 1–12 months 2.5 mL × 2, 1–4 years 5 mL × 2, 5–14 years 10 mL × 2.

Following successful disimpaction, the patients were randomized into two groups to continue maintenance therapy using either oral lactulose syrup in children older than 1 month or oral PEG in children older than 1 year in a dose of 0.2–0.8 g/kg/day. Each group of patients after successful disimpaction was divided into two equal subgroups and were randomized into either lactulose or PEG for follow-up as maintenance therapy for 3 months.

Statistical analysis was done by using chi-squire where $P$ value < 0.1 was statistically significant.

Ethical approval was obtained from the collegiate committee for medical research ethics/university of Mosul after reviewing the research documents and approving protocol on December 29, 2021 (reference No.166 -code: CCMRE-MED-21-57).

## Results

Table 1 shows the demographic study and clinical characteristics of the cases. Most of the patients were under 5 years old (66.15%), with a male-to-female ratio of 1.2:1, and most of the cases were from urban with moderate socioeconomic status. Approximately, 45.15% of patients had symptoms duration between 1 month and 1 year, rice being the most common foodstuff (23.75%), 86.9% of patients had no family history of constipation, 6 patients had surgical problems, 38.39% of them had laxative intake before impaction and fecal impaction with soiling was found in 34.32% of them.

Table 2 shows the relation between the different types of disimpaction methods used and the different responses,

**Table 1: Demographic and clinical characteristics**

| Variable | Frequency | Percentage (%) |
|---|---|---|
| Age | | |
| 30 days–5 year | 63 | −66.15 |
| 6–10 year | 24 | −25.20 |
| >11 year | 18 | −18.90 |
| Gender | | |
| Male | 59 | −61.95 |
| Female | 46 | −48.30 |
| Residency | | |
| Urban | 78 | −81.90 |
| Rural | 27 | −18.37 |
| Socioeconomic status | | |
| High | 18 | −18.90 |
| Moderate | 47 | −49.35 |
| Low | 40 | −42 |
| Duration of constipation | | |
| <1 month | 33 | −34.65 |
| 1 month–1year | 43 | −45.15 |
| >1 year | 29 | −30.45 |
| Special food preferences | | |
| Rice | 19 | −23.75 |
| Sweets | 18 | −22.50 |
| Whole cow's milk | 23 | −28.75 |
| No special food | 30 | −37.50 |
| Family history of functional constipation | | |
| Yes | 19 | −19.95 |
| No | 86 | 90.3 |
| Surgical problems (including thyroid cyst, cleft palate, two cases of hernia, and two cases of hypospadias) | | |
| Yes | 6 | −6.30 |
| No | 99 | 94.2 |
| History of treatment with laxatives | | |
| Yes | 38 | −39.90 |
| No | 67 | −70.30 |
| Type of fecal impaction | | |
| With soiling | 34 | −32.30 |
| Without soiling | 71 | −67.60 |

**Table 2: Initial methods of disimpaction and the responses**

| Initial disimpaction methods | No. of cases | Successful disimpaction | | Unsuccessful disimpaction | | Recurrence of impaction on maintenance treatment | |
|---|---|---|---|---|---|---|---|
| | | *N* | % | *N* | % | *N* | % |
| Manual plus enema | 17 | 12 | 16.4 | 5 | 5.25 | 5 | 5.25 |
| Enema plus lactulose | 19 | 16 | 21.9 | 3 | 3.15 | 3 | 3.15 |
| Enema plus PEG | 13 | 9 | 12.3 | 4 | 4.2 | 2 | 1.9 |
| Lactulose only | 20 | 12 | 16.4 | 8 | 16.8 | 12 | 11.4 |
| PEG only | 11 | 9 | 12.3 | 2 | 6.3 | 3 | 3.15 |
| Bisacodyl suppository followed by PEG | 12 | 8 | 11 | 4 | 4.2 | 2 | 1.9 |
| Glycerin suppository followed by PEG | 13 | 7 | 9.5 | 6 | 6 | 3 | 3.15 |
| Total no. of cases | 105 | 73 | 76.65 | 32 | 33.6 | 30 | 31.5 |

the highest immediate successful responses were in those patients receiving enema + oral lactulose (16.8%) and the highest unsuccessful responses were in those receiving glycerin suppository followed by oral PEG (9.5%). With significant relation, the two-tailed *P* value equals 0.0012.

Table 3 shows the relationship between the initial disimpaction method and the recurrence of fecal impaction during maintenance therapy, the highest recurrence rate was in those patients who received oral PEG following manual + enema (4.9%) and the lowest recurrence rate was in those patients who received oral lactulose following bisacodyl suppository + oral PEG (0%) with no significant relation.

The lowest number of patients with unsuccessful responses was in those who received oral PEG only (6.3%).

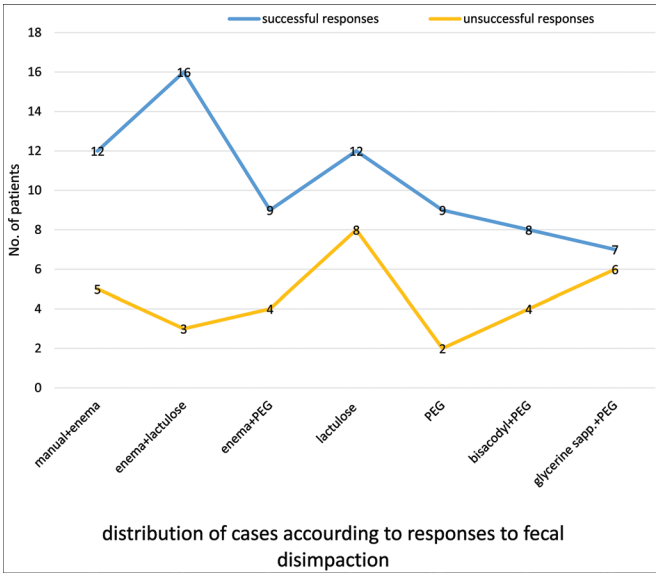
Review your data:

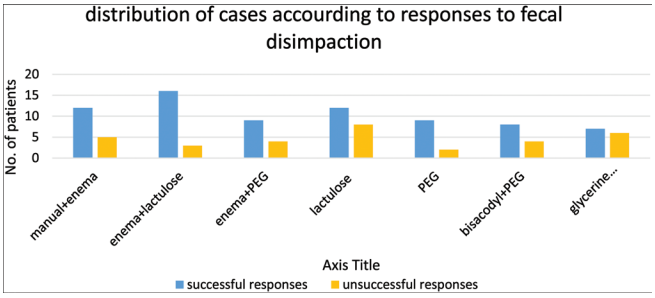
| Group | Group 1 | Group 2 |
|---|---|---|
| Mean | 1.14 | 1.14 |
| SD | 0.69 | 0.90 |
| SEM | 0.26 | 0.34 |
| *N* | 7 | 7 |

Table 4 shows the difference in response between all methods of initial disimpactions that shows a higher successful response in those patients receiving enema + oral lactulose (16.9%) followed by oral lactulose (16.4%).

Review your data:

| Group Mean | Group 1 | Group 2 |
|---|---|---|
| Mean | 10.43 | 4.57 |
| SD | 3.10 | 1.99 |
| SEM | 1.17 | 0.75 |
| *N* | 7 | 7 |



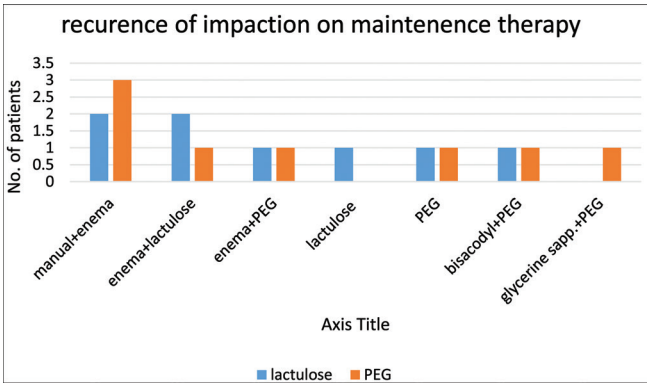



**Table 3: Relationship between the initial disimpaction method and the recurrence of fecal impaction during maintenance therapy**

| Disimpaction method | Patients with successful disimpaction | Drugs used for maintenance therapy | | Recurrence of fecal impaction on maintenance therapy | |
|---|---|---|---|---|---|
| | | Lactulose | PEG | Lactulose *P* value | PEG |
| Manual + enema | 12 (19.7%) | 6 | 6 | 2 (3.27%) | 3 (4.9%) 0.54 not Significant |
| Enema + lactulose | 16 (26.2%) | 8 | 8 | 2(3.27%) | 1 (1.6%) |
| Enema + PEG | 9 (14.75) | 4 | 5 | 1 (1.6%) | 1 (1.6%) |
| Lactulose only | 12 (16.4%) | 6 | 6 | 1 (1.6%) | 0 |
| PEG only | 9 (12.3%) | 5 | 4 | 1 (1.6%) | 1 (1.6%) |
| Bisacodyl support followed by PEG | 8 (13.11%) | 4 | 4 | 1 (1.6%) | 1 (1.6%) |
| Glycerin support followed by PEG | 7 (11.4%) | 3 | 4 | 0 | 1 (1.6%) |
| Total | 73 (100%) | 36 | 37 | 7 | 7 |

Unpaired *t* test results..
*P* value and statistical significance:
The two-tailed *P* value equals 1.0000
By conventional criteria, this difference is considered to be not statistically significant.
Confidence interval:
The mean of group 1 minus group 2 equals 0.00
95% confidence interval of this difference: From −0.93 to 0.93
Intermediate values used in calculations:
*t* = 0.0000
df = 12
standard error of difference = 0.429

**Table 4 Different response to initial disimpaction methods**

| Response to disimpaction | Manual + enema | Enema+ oral lactulose | Enema + oral PEG | Oral lactulose only | Oral PEG only | Bisacodyl support followed by oral PEG | Glyerine support followed by oral PEG | *t* Test |
|---|---|---|---|---|---|---|---|---|
| Successful response | 12 | 16 | 9 | 12 | 9 | 8 | 7 | 0.0012 significant |
| Un successful response | 5 | 3 | 4 | 8 | 2 | 4 | 6 | |
| Total *N* = 105 | 17 | 19 | 13 | 20 | 11 | 12 | 13 | |

Unpaired *t* test results
*P* value and statistical significance:
The two-tailed *P* value equals 0.0012
By conventional criteria, this difference is considered to be very statistically significant.
Confidence interval:
The mean of group 1 minus group 2 equals 5.86
95% confidence interval of this difference: From 2.82 to 8.89
Intermediate values used in calculations:
*t* = 4.2065 df = 12
standard error of difference = 1.392

## Discussion

Fecal impaction is not an uncommon problem in pediatrics and it happens when the stool is too hard or too painful to pass then the child tries to avoid going to the toilet and try to withhold his stool.

Concerning age this study shows a higher incidence of functional constipation with fecal impaction between >1 month and 5 years, this was similar to Tabber *et al*.,[11] which found the most common age group was preschool.

Males were predominance as it is found by Misra *et al*.[13]

Regarding the residence distribution, it was also similar to Walter *et al*.[14] found that a higher incidence of fecal impaction in urban areas.

The duration of symptoms of constipation in most patients in this study was more than 1 month (43.75%) was similar to Benninga *et al*.[15]

A higher incidence of constipation in those patients consuming a low-fiber diet was observed and it is similar to Okuda *et al*.[16]

A higher incidence of fecal impaction without soiling was observed than with fecal soiling (72.5% vs. 27.5%), which is comparable with Heron *et al*.[17]

The failure rate was higher in those patients who received lactulose versus PEG, which is similar to D. Jarzebicka *et al*.[18]

The efficacy of manual plus enema disimpaction versus other methods is not encouraging and the success rate was 16.4%, which is similar to Day[19] found that manual disimpaction is rarely required and oral medication is as effective as rectal medication as the initial method of disimpaction.

The most effective other method found in this study is using enema with lactulose of 16.9% which is similar to Sanders[20] and Shatnawi *et al.*,[3] found that lactulose to be more effective and safer than PEG as an initial method of disimpaction.

The second most effective method was using oral lactulose only(16.4%) while using oral PEG ranked third (12.3%). Dupont *et al*. also found lactulose may be a good alternative to oral PEG as an initial method in the treatment of fecal impaction in constipated children.[3]

This result differs from Poddar's. *et al*.[21] found that both oral lactulose and oral PEG are equally effective and it differs from Jarzebicka *et al*.[18] found that oral PEG is more effective compared with oral lactulose as an initial disimpaction method.

Guest *et al*.[22] found that oral PGE seems to be clinically more effective compared with oral lactulose and cost-effective.

Treepongkaruna *et al.*[23] found that oral PEG has superior efficacy to oral lactulose for the treatment of chronic constipation in young children and is well-tolerated.

This difference could be due small sample size or poor adherence to oral PEG as it is available as powder only in our market.

The study of Shatnawi *et al*. found that all the patients in both groups (oral lactulose and oral PEG) achieved successful disimpaction by the seventh day of the therapy, the oral PEG group showed a significantly faster response. Both therapies were tolerated and no significant adverse events were reported. Both agents were safe, effective, and well-tolerated.

A 3-month study in 96 constipated children aged from 6 months to 3 years confirms the long-term tolerance of oral PEG in pediatrics and indicates an oral PEG efficacy similar to or greater than that of lactulose found by Dupont *et al*.[24]

The bisacodyl and glycerin suppository methods were not promising and it was not as effective as others as it was found by Ellis and Meadows.[25]

Glycerin suppositories are also an effective initial rectal method of disimpaction. It has a better effect when combined with oral PEG but it is not like that seen by using oral lactulose and oral PEG with enema and it was unsuccessful in this study which is unlike the study of Hien *et al*.[26] found good results following combined oral PEG + glycerin suppositories. This could be due to the small sample size.

Oral lactulose is as effective as oral PEG in maintenance therapy to treat functional constipation which is similar to Gremse *et al*.[27] found the same results, but Voskuijl *et al*.[28] found PEG achieves a high success rate with fewer side effects in comparison with oral lactulose.

In this study, no patient was undergoing surgical intervention as a treatment for fecal impaction as all our patients were evaluated by pediatric surgeons before initiation of disimpaction therapy.

## Conclusion

Successful management of fecal impaction and prevention of recurrence need teamwork between patients, family members, and physicians.

The result of using the manual method for disimpaction in comparison to other methods is not conclusive in any harmful way, therefore, it prefers to use other combined rectal medication methods that are less painful and harmful. A high success rate of disimpaction was achieved by combined enema + oral lactulose.

The effectiveness of using either oral lactulose or oral PEG in maintenance therapy shows mixed results. The use of either one may have the same results.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## References

1. Lewis ML, Palsson OS, Whitehead WE, van Tilburg MAL. Prevalence of functional gastrointestinal disorders in children and adolescents. J Pediatr 2016;177:39-43.e3.
2. Tambucci R, Quitadamo P, Thapar N, Zenzeri L, Caldaro T, Staiano A, *et al*. Diagnostic tests in pediatric constipation. J Pediatr Gastroenterol Nutr 2018;66:e89-98.
3. Shatnawi MS, Alrwalah MM, Ghanma AM, Alqura'an ML, Zreiqat EN, Alzu'bi MM. Lactulose versus polyethylene glycol

for disimpaction therapy in constipated children, A randomized controlled study. Sudan J Paediatr 2019;19:31-6.
4. Alnajjar SM, Omer JT, Ali SA. Retrospective study of Hirschsprung's disease in Erbil City/Iraq during 2004–2016. Med J Babylon 2020;17:177.
5. Loening SA, Bonney WW, Fallon B, Gerber WL, Hawtrey CE, Lubaroff DM, *et al*. Cryotherapy. Prostate 1984;5:199-204.
6. Griffin GC, Roberts SD, Graham G. How to resolve stool retention in a child: Underwear soiling is not a behavior problem. Postgrad Med 1999;105:159-61, 165.
7. Borowitz SM, Cox DJ, Kovatchev B, Ritterband LM, Sheen J, Sutphen J. Treatment of childhood constipation by primary care physicians: Efficacy and predictors of outcome. Pediatrics 2005;115:873-7.
8. Motil KJ, Caeg E, Barrish JO, Geerts S, Lane JB, Percy AK, *et al*. Gastrointestinal and nutritional problems occur frequently throughout life in girls and women with Rett syndrome. J Pediatr Gasteroenterol Nutr 2012;55:292-8.
9. Schonwald A, Rappaport L. Consultation with the specialist: Encopresis: Assessment and management. Pediatr Rev 2004;25:278-83.
10. Ejrish AAA. Factors that predict the morbidity of colostomy in patient with ano-rectal malformation in children in Baghdad. Med J Babylon 2016;13:294-306.
11. Tabbers MM, DiLorenzo C, Berger MY, Faure C, Langendam MW, Nurko S, *et al*; European Society for Pediatric Gastroenterology, Hepatology, and Nutrition. Evaluation and treatment of functional constipation in infants and children: Evidence-based recommendations from ESPGHAN and NASPGHAN. J Pediatr Gastroenterol Nutr 2014;58:258-74.
12. Brooks RC, Copen RM, Cox DJ, Morris J, Borowitz S, Sutphen J. Review of the treatment literature for encopresis, functional constipation, and stool-toileting refusal. Ann Behav Med 2000;22:260-7.
13. Misra S, Lee A, Gensel K. Chronic constipation in overweight children. JPEN J Parenter Enteral Nutr 2006;30:81-4.
14. Walter AW, Hovenkamp A, Devanarayana NM, Solanga R, Rajindrajith S, Benninga MA. Functional constipation in infancy and early childhood: Epidemiology, risk factors, and healthcare consultation. BMC Pediatr 2019;19:1-10.
15. Benninga M, Candy DCA, Catto-Smith AG, Clayden G, Loening-Baucke V, Di Lorenzo C, *et al*. The Paris Consensus on Childhood Constipation Terminology (PACCT) group. J Pediatr Gastroenterol Nutr 2005;40:273-5.
16. Okuda M, Kunitsugu I, Yoshitake N, Sasaki S. The relationship between functional constipation and dietary habits in school-age Japanese children. J Nutr Sci Vitaminol (Tokyo) 2019;65:38-44.
17. Heron J, Grzeda M, Tappin D, von Gontard A, Joinson C. Early childhood risk factors for constipation and soiling at school age: An observational cohort study. BMJ Paediatr open 2018;2:e000230.
18. Jarzebicka D, Sieczkowska-Golub J, Kierkus J, Czubkowski P, Kowalczuk-Kryston M, Pelc M, *et al*. PEG 3350 versus lactulose for treatment of functional constipation in children: Randomized study. J Pediatr Gastroenterol Nutr 2019;68:318-24.
19. Day A. Constipation in infants and children. Mod Med 2004;29:18-28.
20. Sanders JF. Lactulose syrup was assessed in a double-blind study of elderly constipated patients. J Am Geriatr Soc 1978;26:236-9.
21. Poddar U, Singh S, Pawaria A, Srivastava A, Yachha SK. Aetiological spectrum, clinical differentiation and efficacy of polyethylene glycol over lactulose in children with constipation: Experience of 316 cases. J Paediatr Child Health 2019;55:162-7.
22. Guest JF, Clegg JP, Helter MT. Cost-effectiveness of macrogol 4000 compared to lactulose in the treatment of chronic functional constipation in the UK. Curr Med Res Opin 2008;24:1841-52.
23. Treepongkaruna S, Simakachorn N, Pienvichit P, Varavithya W, Tongpenyai Y, Garnier P, *et al*. A randomized, double-blind study of polyethylene glycol 4000 and lactulose in the treatment of constipation in children. BMC Pediatr 2014;14:1-9.
24. Dupont C, Leluyer B, Maamri N, Morali A, Joye J-P, Fiorini J-M, *et al*. Double-blind randomized evaluation of clinical and biological tolerance of polyethylene glycol 4000 versus lactulose in constipated children. J Pediatr Gastroenterol Nutr 2005;41:625-33.
25. Ellis MR, Meadows SE. What is the best therapy for constipation in infants? J Fam Pract 2002;51:682.
26. Hien PT, Thoi VH, Ha NT, Kalach N. Efficacy of two regimens for colon cleansing using polyethylene glycol 4000: A randomized open-label trial. Indian Pediatr 2021;58:1119-23.
27. Gremse DA, Hixon J, Crutchfield A. Comparison of polyethylene glycol 3350 and lactulose for treatment of chronic constipation in children. Clin Pediatr (Phila) 2002;41:225-9.
28. Voskuijl W, de Lorijn F, Verwijs W, Hogeman P, Heijmans J, Mäkel W, *et al*. PEG 3350 (Transipeg) versus lactulose in the treatment of childhood functional constipation: A double-blind, randomized, controlled, multicentre trial. Gut 2004;53:1590-4.