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Comparing Diagnostic Methods for Fecal Impaction in Children: Abdominal Exam, Digital Rectal Examination, Medical History, and Trans-abdominal Radiography

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Abstract

Background: In diagnosing and tracking fecal impaction in children with functional constipation, a variety of methods such as history taking, physical examination, digital rectal examination (DRE), and, if needed, imaging-based methods are used. However, the most effective method for tracking this condition remains unclear. Our objective was to evaluate the agreement of medical history and DRE with trans-abdominal radiography as the gold standard for diagnosing childhood fecal impaction.

Material and Methods: In this cross-sectional study, two subgroups of children aged 4 to 10 years with and without fecal impaction were included and evaluated through physical examination, DRE, and trans-abdominal radiography (as the standard), along with a detailed medical history.

Results: The positive abdominal examination in the groups with and without fecal impaction was 33.5% and 7.9%, respectively, indicating a significant difference ($p < 0.001$). In the groups with and without fecal impaction, positive medical history related to functional constipation was revealed in 85.3% and 4.2%, respectively, indicating a significant difference ($p <0.001$). Also, in the DRE method, compared to abdominal radiography, fecal impaction was positive in 85.9% of patients with fecal impact. In comparison, only 8.5% of the control group indicated a significant difference ($p < 0.001$).

Conclusion: A combination of history taking, DRE, and, if necessary, abdominal radiography should be considered to diagnose fecal impaction in children with functional constipation.

Key Words: Abdominal Examination, Child, Constipation, Digital Rectal Examination, Fecal Impaction, Radiography.

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1- INTRODUCTION

Childhood functional constipation is a frequent complaint affecting about 9.5% of children worldwide, resulting in poorer quality of life in this age subgroup (1). This problem is clinically characterized by painful bowel movements without evident organic reasons (2). The Rome IV criteria are now frequently used to diagnose functional constipation. One of the significant criteria for the diagnosis is fecal impaction (3). The initial diagnosis of fecal impaction relies on the digital rectal examination (DRE) to determine the need for disimpaction (4). According to the current guidelines, all children suffering functional constipation with uncertain diagnosis should be indicated for DRE, especially those with alarm signs such as ribbon stool (5). In this regard, assessing the rectal filling state along with DRE can be helpful. However, this method may be unpleasant for the patient and the physician because of its invasive nature (6). Moreover, one of the significant limitations of DRE is the presence of psychological disorders or the patient's unwillingness to undergo this test. Thus, nowadays, there is an intense desire for non-invasive and user-friendly diagnostic tests for assessing childhood functional constipation, especially in addition to fecal impaction (7). Unfortunately, no consensus exists regarding the utility of imaging modalities such as abdominal radiography, ultrasonography, or colonic transit time for assessing fecal impaction. Due to poor diagnostic accuracy and radiation exposure, abdominal radiography is not an acceptable choice for evaluating childhood constipation (8). Besides, abdominal ultrasonography can be applicable for assessing the underlying reasons for constipation, especially for tracking rectal diameter and the expansion of impacted stool (9, 10). Due to ultrasonography's non-invasive, available, and safe nature, there is growing interest in using this tool to assess functional constipation in children. However, many diagnostic and treatment centers still use a combination of clinical examination, DRE, and abdominal radiography as the diagnostic standard for impacted stool. In this study, we aimed to assess the agreement of medical history and DRE with trans-abdominal radiography as the gold diagnostic standard.

2- MATERIALS AND METHODS

2-1. Study Population

The study population consisted of a case group of hospitalized patients aged 4 to 10 years with confirmed fecal impaction through standing abdominal radiography, who were referred to Hajar Hospital in Shahrekord between 2023 and 2024. The control group included children referred to this center for reasons other than fecal impaction. A standing abdominal radiograph with a previous diagnosis of fecal impaction by a radiologist based on relevant indicators was the main inclusion criterion. Parental satisfaction was another criterion for patient selection. Those with recent initiation of medications that cause constipation, such as iron-containing compounds, or with unwillingness to cooperate, were excluded from the study. The study protocol was approved by the ethical committee at Shahrekord University of Medical Sciences with the ethical code IR.SKUMS.MED.REC.1402.047. The study objectives were explained to the participants, and informed consent was obtained before their participation. The confidentiality of the participants' identity information and anonymity were emphasized. Participation in this research did not impose any costs on the participants. Participants could withdraw from the study at any time without giving any reason.

2-2. Study Protocol

This study was conducted on two groups, cases and controls. The case group consisted of 170 children aged 4 to 10 years who had a previous standing abdominal radiography with the radiologist's definitive diagnosis of fecal impaction in the intestine. These indicators on radiological examination included the appearance of a low-density porous mass similar to soft tissue in a dilated large intestine, usually in the rectum. The control group included individuals with demographic characteristics similar to the case group, but who had been referred for reasons other than those affecting bowel function, such as celiac disease, or those affected by bowel function, such as frequent urination. These children had also not recently started taking any medications that affect bowel function, such as iron-containing compounds. The study participants were unaware of the patient's group, and the children's families were also asked to refrain from providing additional information during each step, so blinding was applied in this study. The study was conducted by a pediatric gastroenterologist, three third-year pediatric internal medicine residents with gastroenterology training, and an intern, all following the blinding protocol mentioned above.

The abdominal examination consists of four parts : observation, auscultation, percussion, and palpation. The evidence obtained at each stage is helpful in the diagnosis. In this case, palpation of the mass in the suprapubic area is valuable. Pediatric gastroenterologists and residents performed abdominal examinations of the patients, and each diagnosis's positive or negative result was recorded. Then, the final result of the abdominal examination method was considered by considering the majority result among the four results. In cases of equality, the opinion of the pediatric gastroenterologist was considered. In the next step, the pediatric gastroenterologist, according to the aforementioned blinding method, performed a DRE and recorded the positive or negative result of the diagnosis. The anus was visually examined, and the anal canal and rectum were inspected for the presence of lesions and masses. In this study, the tone of the sphincter muscle, palpation of a hard fecal mass in the rectal roof, or an increase in the diameter of the rectum filled with feces were examined and can be effective in diagnosing fecal mass compaction. Then, the individuals proceeded to take a history from the patients, and the result was determined to be similar to the result of the abdominal examination. In the history, a complete description of the patient's current condition and medical and family history was obtained, which could be helpful in the diagnosis. Descriptions of inability to defecate, severe constipation, progressive abdominal distention, pain during defecation, and soiling of underwear (encopresis) were found to be diagnostically valuable. Following data collection, the diagnostic value of each method was calculated individually and compared with the other methods mentioned. Additionally, the relationship and frequency of risk factors and complications related to fecal impaction were examined. All patients were requested to have urine analysis and culture to diagnose urinary tract infection, TSH and Free T4 to diagnose new cases of hypothyroidism, and IgA and TTG-IgA tests to investigate celiac disease. If the results of each test were positive, subsequent relevant measures such as endocrinology consultation or endoscopy were performed, and the patient's treatment continued. The checklist containing risk factors and complications of fecal impaction mentioned earlier was completed by the researcher with the help of history from the parents of the affected children, review of test results, and

examinations with the approval of the pediatric gastroenterologist to study their effectiveness and incidence.

2-3. Statistical Analysis

Descriptive statistics were reported using numbers, percentages, mean and standard deviation. To analyze the main objectives, sensitivity, specificity, positive and negative predictive values were calculated by creating two-by-two tables. The kappa agreement coefficient was used to assesse agreement between the methods being studied. For the analysis of secondary objectives, such as examining risk factors and complications, two-sample independent t-tests and chi-square tests were used. All analyses were performed in SPSS version 23, with p-values less than 0.05 were considered significant.

3- RESULTS

Baseline characteristics of the study population are presented in Table 1. The two groups with and without fecal impaction were similar in mean age, gender, mean birth weight, mean gestational age at birth, economic level of the family, and place of residence.

Regarding clinical manifestations related to constipation (Table 2), the group with fecal impaction had a more extensive history of severe fecal retention, difficult or painful bowel movements, passing large-diameter stools causing blockage of the toilet, voluntary fecal retention and creating a unique position for this purpose compared to the other group. There were also significant differences in the number of bowel movements per week and the number of times of fecal incontinence per week between the groups with and without fecal impaction.

Considering baseline risk factors related to fecal impaction (Table 3), the prevalence rate of family history of constipation, insufficient fiber in the diet, sleep problems, obesity, anticholinergic drug use, and history of allergy to Cow's milk protein were all more frequent in the group with fecal impaction.

The positive abdominal examination in the groups with and without fecal impaction was 33.5% and 7.9%, respectively, indicating a significant difference ($p < 0.001$). The crude agreement between the abdominal examination method and the standard method (abdominal radiography) to detect fecal impaction was 0.623, and the kappa coefficient of agreement was 0.25, indicating a strong agreement between the two approaches ($p < 0.001$). In this regard, the sensitivity, specificity, positive predictive value, and negative predictive value of abdominal examination to detect fecal impaction in the studied children were 33.0%, 92.0%, 81.0%, and 57.0%, respectively.

Table-1: Baseline characteristics of study subjects.

Characteristic		Group with fecal impaction (n = 170)	Group without fecal impaction (n = 165)	p-value
Mean age, year		5.99±1.93	6.05±1.70	0.79
Gender, %	Male	99 (58.2)	94 (57.0)	0.83
	Female	71 (41.8)	71 (43.0)	
Place of residence, %	Rural	65 (38.2)	53 (32.1)	0.24
	Urban	105 (61.8)	112 (67.9)	
Low economic level, %		43 (25.3)	30 (18.1)	0.12
Mean birth weight (gram)		3121.1±396.8	3175.1±526.5	0.29
Mean gestational age (weeks)		37.82±2.0	37.75±1.9	0.77

Table-2: Gastrointestinal findings in study subjects.

Characteristic	Group with fecal impaction (n = 170)	Group without fecal impaction (n = 165)	p-value
History of severe fecal retention	114 (67.1)	0 (0.0)	<0.001
History of difficult or painful bowel movements	161 (94.7)	0 (0.0)	<0.001
History of passing large-diameter stools that cause blockage of the toilet	125 (73.5)	0 (0.0)	<0.001
The presence of a large-diameter fecal mass in the intestine	146 (85.9)	14 (8.5)	<0.001
History of voluntary fecal retention and creating a special position for this purpose	87 (51.2)	0 (0.0)	<0.001
Number of bowel movements per week	3.22±1.27	4.47±1.28	<0.001
Number of times of fecal incontinence per week	1.82±0.39	0.07±0.03	<0.001

In the groups with and without fecal impaction, positive medical history related to functional constipation was revealed in 85.3% and 4.2%, respectively, indicating a significant difference ($p < 0.001$). The crude agreement between the medical history assessment and the standard method was 0.90, and the kappa coefficient of agreement was 0.81, which was statistically significant ($p < 0.001$). We found a sensitivity of 85.0%, a specificity of 95.0%, a positive predictive value of 95.0%, and a negative predictive value of 86.0% for medical history assessment to diagnose fecal impaction.

In the DRE method, compared to abdominal radiography, out of 170 cases in the case group, fecal impaction was positive in 146 people (85.9%). In contrast, out of 165 people in the control group, fecal impaction was reported to be positive in 14 people (8.5%), indicating a significant difference ($p < 0.001$). The crude agreement between the DRE and the standard radiography methods was 0.88, and the kappa agreement coefficient was 0.77 ($p < 0.001$). DRE could effectively detect fecal impaction with a sensitivity of 85.0%, a specificity of 91.0%, a positive predictive value of 91.0%, and a negative predictive value of 86.0%.

4- DISCUSSION

4-1. Diagnostic Validity of Clinical Methods

This study aimed to evaluate the agreement of medical history and DRE with trans-abdominal radiography, which served as the gold standard for diagnosing childhood fecal impaction. Classical methods such as clinical history, physical examination, and DRE could be useful for diagnosing fecal impaction in children. The study found that the physical examination method (mainly superficial abdominal examination) did not have the necessary specificity or negative predictive value for diagnosing fecal impaction. However, it did have acceptable sensitivity and positive predictive value. In addition,

the two methods of taking a history and the DRE method had an acceptable status regarding sensitivity and specificity. More interestingly, even the clinical history method can be of more excellent value for tracking fecal compaction than the DRE method. In other words, the final diagnosis of fecal impaction is primarily based on clinical manifestations and medical history of patients suspected of having this condition, and other methods can complement the aforementioned diagnosis. The authors of this plan emphasize the use of detailed clinical history along with other methods and, if necessary, using trans-abdominal radiography. This emphasizes the crucial role of a comprehensive clinical history in the primary diagnosis of fecal impaction, while other methods act as supportive tools.

Table-3: Risk factors related to fecal impaction.

Characteristic	Group with fecal impaction (n = 170)	Group without fecal impaction (n = 165)	p-value
Family history of constipation	91 (53.5)	34 (20.6)	<0.001
Previous diagnosis of constipation	97 (57.1)	29 (17.6)	<0.001
Insufficient fiber in the diet	50 (29.4)	16 (9.7)	<0.001
Insufficient water and fluid intake	2 (1.2)	19 (11.5)	0.49
Special diet	6 (3.5)	0 (0.0)	0.03
Stool retention and delayed bowel movements	70 (41.2)	16 (9.7)	<0.001
Painful bowel movements	96 (56.5)	4 (2.4)	<0.001
Sleep problems	25 (14.7)	6 (3.6)	<0.001
Insufficient or no physical activity	18 (10.6)	7 (4.2)	0.27
Obesity	34 (20.0)	16 (9.7)	0.008
Anticholinergic drug use	19 (11.2)	0 (0.0)	<0.001
Iron-containing medications	3 (1.8)	5 (3.0)	0.49
Cystic fibrosis	1 (0.6)	0 (0.0)	0.99
Celiac disease	3 (1.8)	0 (0.0)	0.24
Hypothyroidism	3 (1.8)	1 (0.6)	0.32
Cerebral palsy	3 (1.8)	0 (0.0)	0.24
Mental retardation	4 (2.4)	0 (0.0)	0.12
Physical disabilities	3 (1.8)	0 (0.0)	0.24
Cow's milk protein allergy	20 (11.8)	1 (0.6)	<0.001
Surgical history	6 (3.6)	1 (0.6)	0.24

4-2. Comparison with Previous Studies

A study reported no correlation between fecal impaction detected by abdominal radiography and total colonic transit time. However, plain radiographs can be a helpful tool in diagnosing fecal impaction (11). A review study indicated insufficient evidence to justify the inclusion of abdominal X-rays in the diagnostic evaluation of functional constipation (12). In line with our study results, previous studies have also emphasized the importance of clinical history and examinations to detect fecal impaction. In a study by Araghizadeh in 2005 (13), following a complete history and physical examination, plain abdominal films are indicated to search for intraluminal feces or signs of fecal impaction, mainly if signs of bowel obstructions are observable. They expressed that the previous history of impaction is found only in 39.0% of affected children.

Regarding the value of different methods to detect fecal impaction, Modin et al. in 2015 (14) showed that rectal examination identified fecal impaction in 66.2%, and of the children with fecal impaction, 12.8% only had one additional Rome III criterion. Studies on the value of DRE in detecting fecal compaction in children with functional constipation have provided mixed results on the usefulness of this method. However, the importance of this method is still emphasized if the patient agrees to perform this examination. A study revealed that transabdominal ultrasound is a non-invasive and dependable method to assess rectal filling, potentially as a substitute for DRE in evaluating children with constipation (15).

Pradhan et al. (16) believed that DRE could detect cases of impaction not discernible by other means. In their experiment, 28.4% of children had impaction detectable without DRE, while among the rest, 30.1% had impaction by DRE. However, some also argued that the digital method was not effective enough to track stool compaction in children. Gold et al. indicated that by using DRE, only 54% of children had fecal impaction, and only 21% had minimal to no stool retention on DRE assessment (17).

In this study, abdominal radiography was considered the gold standard for detecting fecal impaction. However, there is evidence that radiography also has diagnostic limitations in diagnosing constipation and its associated fecal impaction and does not even have sufficient agreement with clinical assessment methods. As shown in a systematic review by Reuchlin-Vroklage et al. (18), the best-evidence synthesis yielded conflicting evidence for an association between a clinical and a radiological diagnosis of constipation. Their study found conflicting evidence for an association between DRE and fecal impaction on radiography. Relying only on one of the evaluated methods for the rapid and definitive diagnosis of fecal impaction is not reasonable. Considering a set of conditions such as patient satisfaction and clinical status and contraindications of each diagnostic approach, combining these methods can be most beneficial for detecting fecal impaction in children.

4-3. Clinical Implications for Diagnosis and Management

Due to the diagnostic limitations inherent in any single method, a multimodal approach is advised for detecting fecal impaction in children. A comprehensive medical history should form the foundation of the diagnosis, supplemented by a DRE when appropriate. Radiographic imaging should be reserved for situations with ambiguous clinical findings or when complications such as bowel obstruction are suspected. Additionally, recent advancements indicate that transabdominal ultrasound may be a non-invasive alternative to DRE for

evaluating rectal filling, thus providing an additional diagnostic option.

4-4. Limitation of the Study

The cross-sectional design of the study prevented the establishment of causality, and its implementation within a single hospital limited its generalizability. Selection bias is possible, as the study only included hospitalized patients, potentially omitting milder cases. Although blinding was employed, subjective evaluations such as abdominal and DRE remain susceptible to observer or practitioner bias. Furthermore, while abdominal radiography was utilized as a reference standard, it has inherent limitations in detecting fecal impaction.

5- CONCLUSION

It can finally be concluded that when considering trans-abdominal radiography as the standard method, the two methods of obtaining a detailed clinical history and DRE have acceptable sensitivity and specificity in detecting fecal impaction in children. However, relying solely on abdominal examination is not very effective due to its low sensitivity. The DRE has demonstrated high sensitivity in detecting fecal impaction, affirming its value as a diagnostic tool. Significant differences identified between impacted and non-impacted groups suggest that healthcare practitioners should prioritize clinical evaluation before resorting to imaging techniques. Abdominal radiography can be utilized as a supplementary tool when clinical uncertainty persists. These results advocate for a structured approach that combines medical history-taking, physical examination, and selective imaging to ensure an accurate diagnosis and effective management of fecal impaction in pediatric patients.

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7-CONFILCT OF INTEREST

The authors declared that there are no conflicts of interest.

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