Journal of Clinical Pediatrics Research

ISSN-2583-4525
Kapoor A, 2024-J Clin Ped Res
Short Communication

Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach

Atul Kapoor*

Advanced Diagnostics and Institute of Imaging, Amritsar, Punjab, India

***Corresponding Author:** Atul Kapoor, Advanced Diagnostics and Institute of Imaging, Amritsar, Punjab, India.

Received Date: 04-29-2024

Accepted Date: 05-10-2024

Published Date: 05-25-2024

Abstract

Diarrhea in children has a world-wide prevalence. Acute diarrhea is usually infective in origin and self-limiting. It is only in severe cases that it needs hospitalization and investigations. Chronic diarrhea in children is by definition "is one with frequent passage of stools lasting for more than three weeks duration" and has a multifactorial etiology requiring history taking, laboratory and imaging studies for determining the cause. High resolution ultrasonography and recently shear wave elastography of the gut have emerged as useful tools which help to evaluate these patients. In this short commentary the author describes the application of these modalities in a systematic manner and discusses the road map based on its findings to triage children with chronic diarrhea.

Keywords: Diarrhea; Chronic; High resolution ultrasonography.

Introduction

Diarrhea in children has a worldwide prevalence and it is estimated that more than 5 million children succumb to the disease worldwide and is the fifth largest cause of mortality in third-world countries [1]. An operative definition of diarrhea as proposed by the World Health Organization refers to the passage of three or more loose or liquid stools per day or more frequently than is normal for the individual based on the duration of symptoms. It can be classified as acute, i.e. less than 14 days duration and chronic if more than three weeks duration [2]. Acute diarrhea is usually infective in origin-viral or bacterial while the latter may be complicated by the passage of blood in stools or sepsis and may require hospitalization and imaging evaluation in severe cases. Pathophysiology of chronic persistent pediatric diarrhea is multifactorial and complex and is due to persistent intestinal mucosal injury due to chronic or sequential

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019

gut infections example, shigella, host factors like micronutrient deficiencies and altered immune status. Persistent gut mucosal inflammation leads to deficient mucosal repair and increased susceptibility to pathogens and harmful dietary antigens [3]. Hence there is a potential challenge to detect chronic inflammatory mucosal changes by imaging or by the use of blood tests or even invasive procedures like enteroscopy. Most of these patients present with history of passage of loose stools of more than two weeks duration with or without blood in stools, abdominal distension, features of malabsorption, nutritional deficiencies and failure to thrive.

Discussion

Evaluation of a patient with chronic diarrhea starts with age, history taking, physical examination followed by routine hematological tests, stool examination for pathogens, fat content, blood electrolytes, serum albumin while others are specific like Hydrogen breath test, transaminase-IGA, fecal calprotectin. There is however a tendency amongst gastroenterologists to straight away proceed for enteroscopy followed by mucosal biopsy for a suspected enteropathy as the cause. Nearly all the above non-invasive tests fail to detect bowel wall changes and stage the extent of disease or damage. Hence there is a need for non-invasive imaging tools [4,5].

Traditionally grey scale ultrasonography (USG) has been used to evaluate small bowel. Using high-frequency transducers with a graded compression technique the different layers of the bowel can be distinctly visualized (Figure 1A) along with wall thickness measurement. The condition of surrounding mesentery, lymph nodes, and peritoneal fluid can also be visualized accurately using USG. It has 100% sensitivity and specificity to rule out intestinal intussusception and has a high sensitivity for appendicitis. USG however has a limited specificity in determining the detection and cause of inflammatory bowel diseases.

Recent advances in imaging, i.e. shear wave elastography (SWE) have opened up newer applications of SWE to evaluate small bowel in patients with both acute and chronic diarrhea. The technique involves the generation of shear waves using ultrasound and with the same transducer the shear waves cause displacement of the soft tissues in the region of interest. The speed of these waves is calculated, and the stiffness is determined in kilopascals. Recently a new parameter of shear wave dispersion (SWD) has also been added which measures the viscosity of the tissues and is an indirect imaging marker of inflammation (Figure 1B). Using newer imaging techniques Kapoor A, et al. [6], for the first time proposed SWE and IUS as a first-line technique to triage patients of chronic diarrhea as depicted in the workflow Figure 2. The patients were divided into inflammatory and non-inflammatory group. Patients with non-inflammatory group had normal SWE and IUS and were referred for further tests to determine the cause. Patients with inflammatory/infective cause were further divided into three groups based on the findings of SWE imaging.

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019

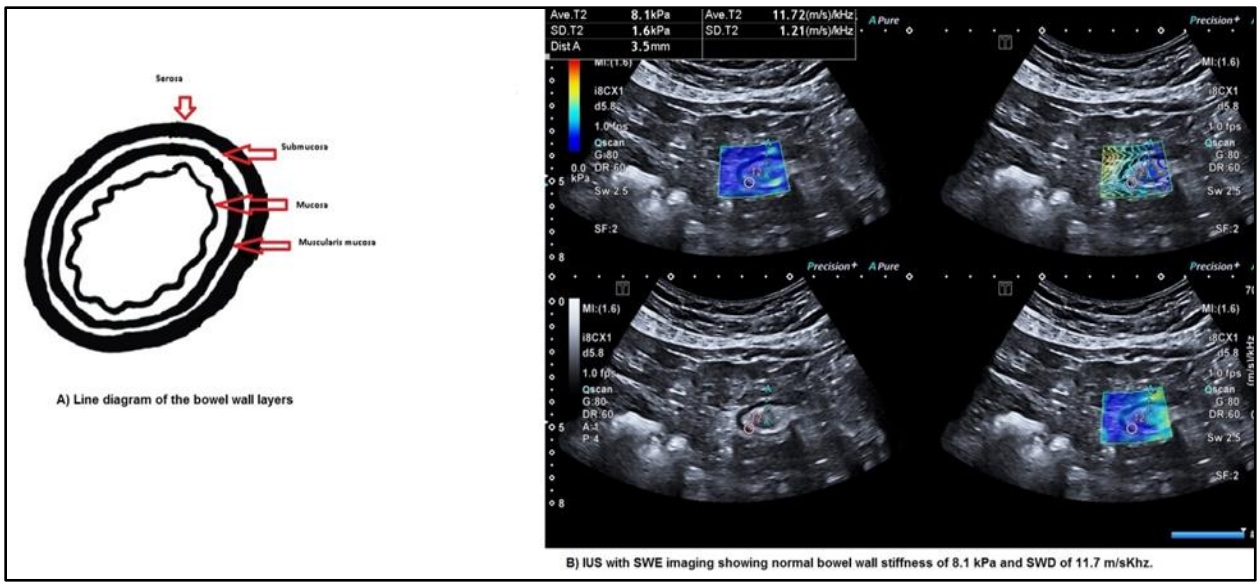

Figure 1: A) Line diagram of bowel wall showing different layers of the wall. B) IUS and SWE images showing bowel wall layers with normal wall stiffness (SWE) in Kilopascals and inflammation measured in SWD as m/s/kHz.

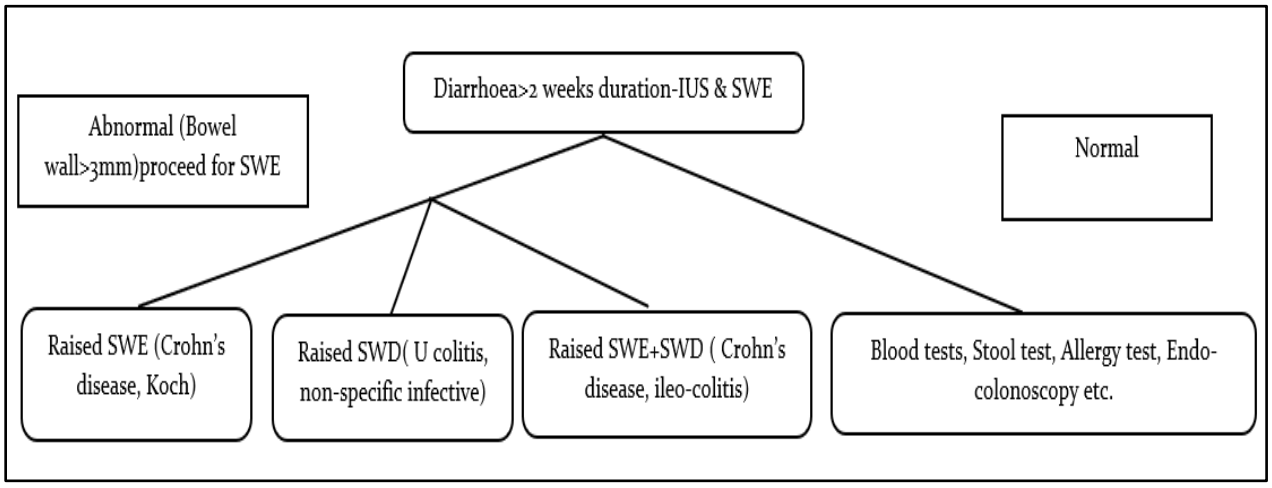

Figure 2: The workflow chart of the first-line technique to triage patients of chronic diarrhea.

Group I patients with increased bowel wall thickening >3mm usually show some luminal narrowing and on SWE have increased wall stiffness more than 22 kPa with stricture formation. Patients with intestinal Koch had wall stiffness of more than 30 kPa (Figure 3). Due to the systematic use of the two-step scheme of evaluation using IUS and SWE, one could not only diagnose inflammatory bowel disease but can also differentiate inflammatory from fibrotic bowel thickening and suggest its etiology [7]. Ślósarz D, et al. [8], also in the systematic review suggested the role of SWE as a promising tool to evaluate bowel inflammatory conditions.

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019

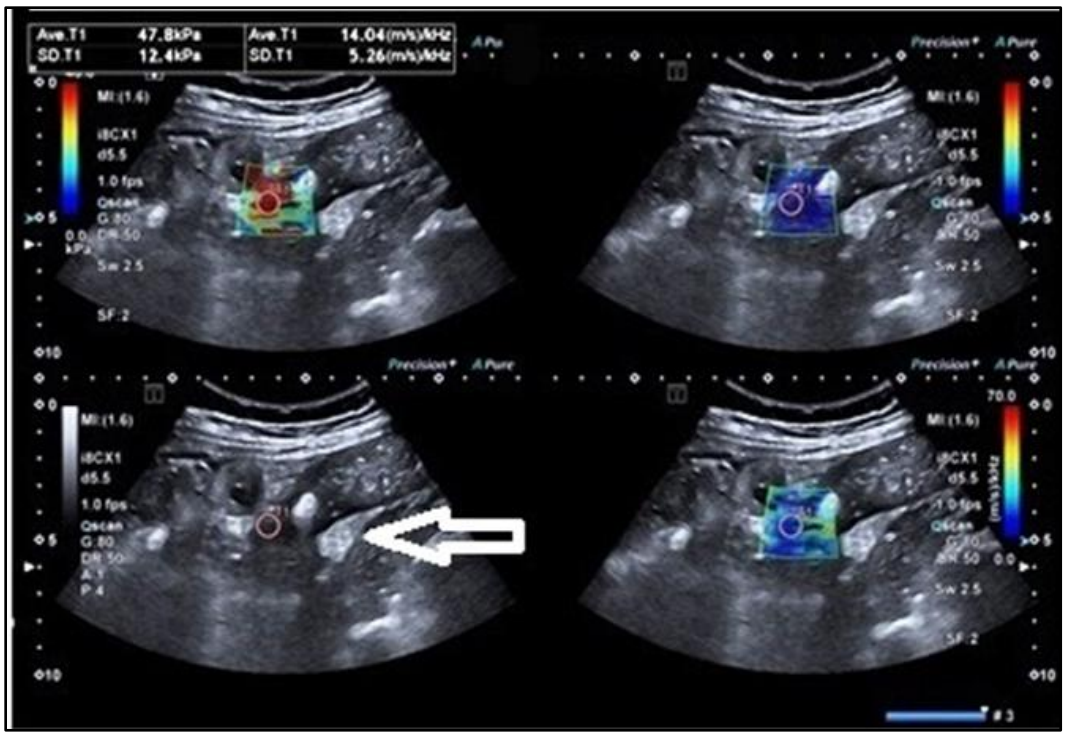

Figure 3: SW image of patient with Short segment ileal narrowing (arrow) with SWE of 47.8kPa and SWD of 14.0m/s/kHz of a patient with terminal ileal Kochs.

Group II patients were those who showed thickened bowel walls with preserved bowel stratification. The SWD which is a noninvasive marker of inflammation was alone increased in this group with the submucosal layers being affected predominantly. This pattern was characteristic in patients with ileocolitis (Figure 4). In the study by Kapoor A, et al. [6], a poor sensitivity of 27% by Computed tomography to detect bowel inflammation was observed compared to 100% by the use of SWE. Similar results have also been shown by Allocca M, et al. [9], in the study.

Group III patients are those with increased SWE and SWD and need corroborative tests to reach final diagnosis as these findings can be observed in early Crohn's disease, partially treated infective ileo-colitis. The ancillary imaging findings like increased bowel vascularity, regional lymph nodes, and mesenteric creeping fat sign may also be helpful imaging features in making a differential diagnosis. The ability to directly detect inflammation by the use of SWD has made SWE a unique tool to directly detect and quantify tissue inflammation, unlike the use of inflammatory serum biomarkers like C reactive protein, erythrocyte sedimentation rate, Interleukin levels which are all indirect markers.

Even fecal calprotectin being a specific test of inflammatory bowel disease does not depict the site of bowel inflammation. Hence, SWE becomes a tool with immense potential in the evaluation of all such patients.

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019

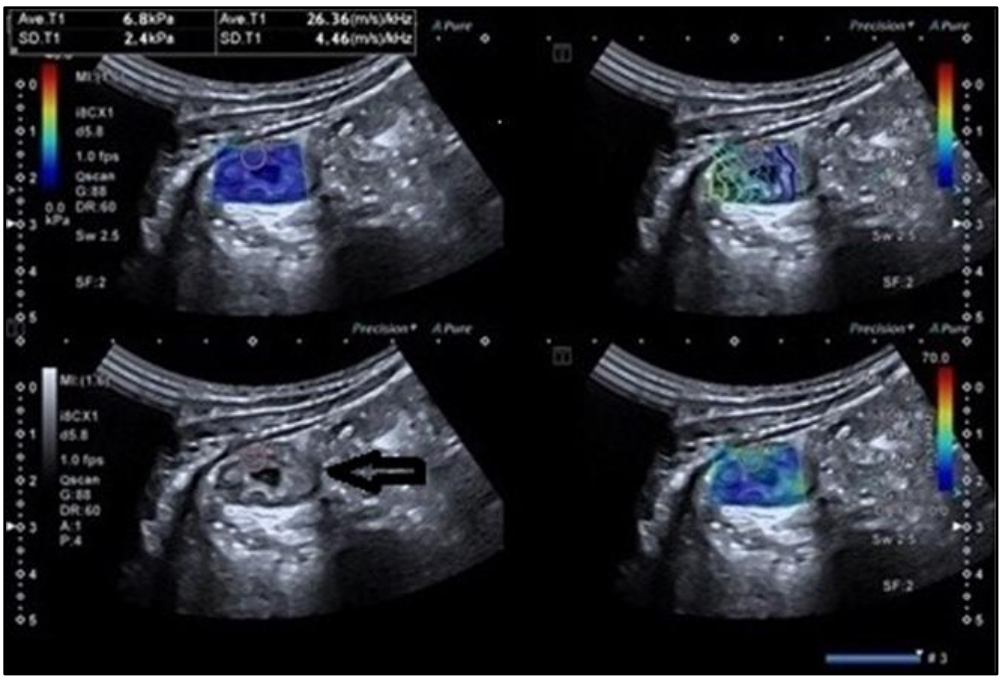

Figure 4: SW image of patient with chronic colitis with submucosal thickening (arrow) inflammation with raised SWD of 25.4ms/kHz and normal wall stiffness of 6.8kPa.

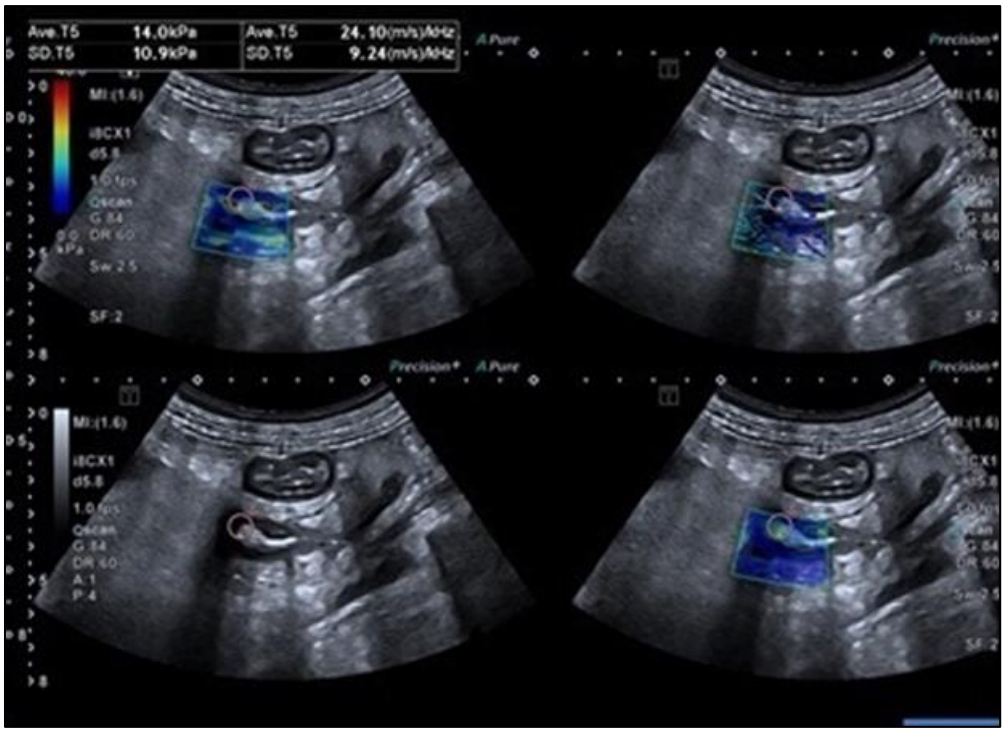

Figure 5: A patient with Crohn disease with increased bowel stiffness of 14kPa and SWD of 24.10m/s/kHz.

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019

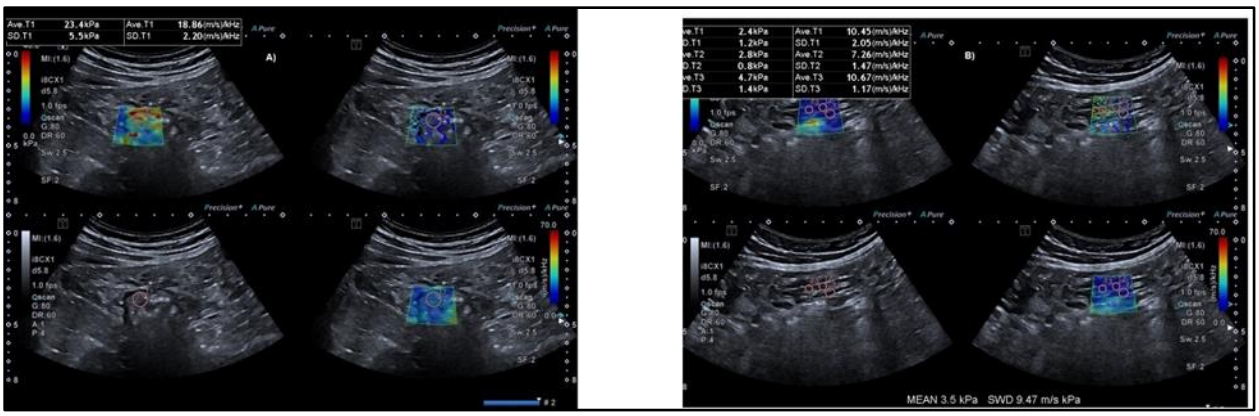

Figure 6: A) SW and IUS image in a 12 year old child with chronic diarrhea showing thickened ascending colon with increased bowel stiffness of 23.4kPa and SWD 18.6 m/s/kHz. B) Post treatment three weeks follow up scan showing normal colon wall with normal stiffness and SWD.

All those who have a normal imaging examination may then proceed to other panel of hematological, stool, and even invasive endo-colonoscopic evaluations or even mucosal biopsies to reach to final diagnosis. The role of other imaging modalities like contrast-enhanced tomography and magnetic resonance imaging may be used to stage the extent of disease. This approach is not only cost-effective but saves the pediatric patient from the use of intravenous contrast and is also radiation free [10]. Shear wave imaging has certain limitations namely like any other ultrasound based imaging modality there is operator dependence, availability and operative skill are others. Not many ultrasound vendors have the complete spectrum of shear wave imaging i.e. shear wave stiffness and dispersion. Lastly, being a new imaging modality there is still a lack of guidelines on its use. Only a few studies have been done so far using SWE to monitor inflammatory activity of bowel [11,12]. C-reactive protein and fecal calprotectin have been used as surrogate biomarkers of bowel inflammation but have limitations with 20% patients being missing. Hence, the need for a more robust biomarker. So far there is paucity of literature on the use of SWI and IUS and its role in patients with chronic diarrhea. As more work is done, the guidelines shall emerge on the use based on the multicentre experiences.

Conclusion

The author feels that the above algorithm based on the use of SWI and IUS forms a cost effective first step test to triage pediatric patients of chronic diarrhea into inflammatory and non-inflammatory categories. Patients with non-inflammatory and non-infective causes can be put on respective dietary modifications, peristalsis controlling medications. Specific blood and stool tests can be done for respective groups which can not only be more cost effective and time saving. Even during follow up of such patients a combined SWI and IUS can effectively confirm the complete post treatment remission of disease and save the patient from repeated enteroscopies and from radiation of a CT scan.

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019

References

1. World Health Organization. Diarrhoeal Disease Fact Sheet N 330. 2017.
2. Troeger C, Blacker BF, Khalil IA, Rao PC, Cao S, Zimsen SR, et al. Estimates of the Global, Regional, and National Morbidity, Mortality, and Aetiologies of Diarrhoea in 195 Countries: A Systematic Analysis for the Global Burden of Disease Study 2016. Lancet Infect Dis. 2018;18(11):1211-28. PubMed | CrossRef
3. Sullivan PB. Studies of the Small Intestine in Persistent Diarrhea and Malnutrition: The Gambian Experience. J Pediatr Gastroenterol Nutr. 2002;34:S11-3. PubMed | CrossRef
4. Thiagarajah JR, Kamin DS, Acra S, Goldsmith JD, Roland JT, Lencer WI, et al. Advances in Evaluation of Chronic Diarrhea in Infants. Gastroenterology. 2018;154(8):2045-59. PubMed | CrossRef
5. Fine KD, Schiller LR. AGA Technical Review on the Evaluation and Management of Chronic Diarrhea. Gastroenterology. 1999;116(6):1464-86. PubMed | CrossRef
6. Kapoor A, Singh A, Kapur A, Mahajan G, Sharma S. Use of Shear Wave Imaging with Intestinal Ultrasonography in Patients with Chronic Diarrhea. J Clin Ultrasound. 2024;52(2):163-75. PubMed | CrossRef
7. Zhang M, Xiao E, Liu M, Mei X, Dai Y. Retrospective Cohort Study of Shear-wave Elastography and Computed Tomography Enterography in Crohn's Disease. Diagnostics (Basel). 2023;13(11):1980. PubMed | CrossRef
8. Ślósarz D, Poniewierka E, Neubauer K, Kempiński R. Ultrasound Elastography in the Assessment of the Intestinal Changes in Inflammatory Bowel Disease-systematic Review. J Clin Med. 2021;10(18):4044. PubMed | CrossRef
9. Allocca M, Fiorino G, Bonovas S, Furfaro F, Gilardi D, Argollo M, et al. Accuracy of Humanitas Ultrasound Criteria in Assessing Disease Activity and Severity in Ulcerative Colitis: A Prospective Study. J Crohns Colitis. 2018;12(12):1385-91. PubMed | CrossRef
10. Üstüner E. Shear Wave Elastography and Dispersion Imaging in Intestinal Ultrasound in the Setting of Chronic Diarrhea. J Clin Ultrasound. 2024;52(2):176-7. PubMed | CrossRef
11. Wilkens R, Novak KL, Maaser C, Panaccione R, Kucharzik T. Relevance of Monitoring Transmural Disease Activity in Patients with Crohn's Disease: Current Status and Future Perspectives. Therap Adv Gastroenterol. 2021;14:17562848211006672. PubMed | CrossRef
12. Colombel JF, Narula N, Peyrin-Biroulet L. Management Strategies to Improve Outcomes of Patients with Inflammatory Bowel Diseases. Gastroenterology. 2017;152(2):351-61. PubMed | CrossRef

Citation: Kapoor A. Evaluation of Chronic Pediatric Diarrhoea-Use of Newer Imaging Tools: A More Practical Approach. J Clin Ped Res. 2024;3(1):64-70.
DOI: https://doi.org/10.37191/Mapsci-2583-4525-3(1)-019