Minireview Article

EXPLORING THE FACTS REGARDING COLON TRANSIT STUDY IN CHILDREN

ABSTRACT

Aim: Constipation is a problem faced by many children around the world. There are different ways of diagnosis and management of this condition. The key to the right diagnosis is based on the series of investigation that differs with children. The subject of interest is often the amount of time it takes for a substance to move through the colon which is known as Colon Transit Time[CTT]. Colon transit study or radio-opaque marker [ROM] study otherwise known as pellet study is one of the first choices of treatment to identify the CTT. Describing the colon transit study based on the established findings is the aim of this study.

Method: The MeSH terms used for literature retrieval were 'marker studies in children', 'pellet study in children', 'colon transit study in children'. The retrieval was performed based on pubmed, EMBASE, Web of Science as well as official websites. The search found 31 studies published from 2002 to 2022, as being met the inclusion criteria.

Results: The existing studies have identified a systematic way of performing the colon transit studies in children in many different ways. The colon transit differs with the segment of the colon and the age group of children.

Conclusion: Although the colon transit study requires series of intervention and investigation, the exact way of performing the same depends on the policies and protocols adopted by the individual specialist health care setting.

Key-Words: Colon Transit Time, Colon Transit study, pellet study

ABBREVIATIONS

CTT- Colon Transit Time

ROM- Radio-opaque Marker

VCE- Video Capsular Endoscopy

ARM-Ano-rectal manometry

1.INTRODUCTION

Constipation is a common problem in children and adults with a prevalence of 3% worldwide, but it is surprising that even about 29% of population has been reported to have the same globally[1]. Most of the children with chronic constipation are managed in primary and secondary health care centres. However, a major proportion of children require referrals to specialist centres, which further brings an inflation to the cost of healthcare[2]. Majority of the children have functional constipation which satisfies two or more of the criteria defined by Rome IV consensus[3]. These children do not need specialised investigations[3]. But, thirty-three percentage of children with constipation do not respond positively, so that they require diagnostic evaluation[4]. These kids are said to have intractable constipation, which is defined as poor response to optimum therapy for at least 3 months[5]. The consequence of this on the children and their families is detrimental. Therefore, this needs careful assessment and evaluation to bring out positive results. However, prior to adopting diagnostic strategies, it is essential to determine the effectiveness and compliancy with the use of laxatives.

The pathophysiology of constipation throws light on the coordination and integrity of the nerves and muscles in the colon, rectum and anus; how quickly the bolus passes through the colon and the way the faeces are expelled from the rectum[6].

There are different methods to assess each of the physiological processes, at the same time, there are limitations for each of them. Manometry studies of the colon permits the neuromuscular contraction studies, but it does not evaluate the problems with faecal expulsion or transit times[7]. There are radiopaque marker (ROM) studies which is advantageous in this regard, but has the risk of exposure to radiation and also the markers advance through the colon differently in comparison to the faeces[8]. Video Capsule Endoscopy [VCE] and scintigraphy, which are the other set of investigations,

can only be performed in highly specialised centres. Ano- Rectal Manometries [ARM] are also performed but this evaluates only the anus and the rectum.

As there are no tests which can be described as complete, nine reviews identify the tests to determine the function of the colon as - first line screening and in-depth second line investigations. This is divided so, based on the complexity, accessibility and successful nature of the investigations. This article is about the colon transit marker studies which is categorised as one of the first line investigations as per ten different researches. Any searches with unavailability of the full texts or complete information have been excluded from the study.

There are a number of indications for performing the colon transit studies according to eight studies, which were finally included in the review. Identification of children with faecal retension and to exclude them from the non-retentive faecal incontinence is an aim of transit marker study[5,6,9,10]. It also helps in determining the type of constipation as to whether it is slow transit, segmental or recto-sigmoid delay[11-14]. Marker studies are also used as a screen before any major second-line tests of motility are done[15]. Also, when there are uncertainties in the diagnosis after the symptoms are revealed or to detect the effectiveness of medications, the marker studies are carried out[5,16-19].

2.METHOD OF PERFORMING COLON TRANSIT MARKER STUDIES

The method of colon transit marker studies have been established by eight different authors. It can involve ingestion of single or sequential capsules which contain similar shaped or different shaped markers. This would follow X-rays which can either be single or in series.

With the single capsule technique, the patient consumes a single capsule containing 20 markers on day 1. The X-rays are done on Day 3and Day 5 of the capsule swallow[20]. Otherwise, X-rays can be done every 24 hours. The latter method helps evaluate the total and segmental transit times. But, to schedule an X-ray same time every day is practically inconvenient and has high risk of radiation exposure in smaller children. Sometimes, X-rays are done only on Day 5. However, this does not assess fast transit and has no quantitative evaluation of Colon Transit Time[CTT]. This method is also differently done with the ingestion of a single capsule containing 24 markers followed by X-rays only

on Day5[8]. The most common method is ingestion of capsules containing 20 markers each on days 1, 2 and 3 followed by single X-ray on Day 4 or sequential X-rays on Day 4 and 7 and if more than 20% of the markers are remaining, further X-ray investigations are done[21]. There are uncommon methods of ROM as well. In one of them, a capsule containing 10 ring shaped markers is to be taken for 6 consecutive days followed by an additional capsule containing 20 rod shaped markers on days 4,5 and 6[22]. One single X-ray shot is taken on day 7, 24 hours after ingestion of the last capsule. However, this method is highly impractical in children.

As individual capsules contain pellets of markers, this test is also called pellet study. It is important that the children consume capsules the same time each day[23]. Also, if they cannot swallow capsules as a whole, the pellets can be mixed with food items and then ingested. Impacted colon is found to affect the study[24,25] , but disimpaction can be a challenge in practice. Any medication that affects the gastric motility [For example, laxatives] may need to be withheld depending on the individual need of the child, unless the test is done to detect the effect of medication.

3.INTERPRETATION OF THE RESULTS

The evidence for interpretation of the results for colon transit studies have been identified in nine different studies. The results of the marker studies can be interpreted both qualitatively and quantitatively[18,19].

To evaluate the marker studies ***qualitatively***, the colon is divided into projection zones as right, left and rectosigmoid colon. This is done by dividing the abdominal radiograph such that a straight line overlays the spinal processes. Two imaginary lines from the fifth lumbar vertebra extending respectively to the left iliac crest and right pelvic outlet intersects the straight line such that the three quadrants are created[26]. Visual inspection of the X-ray for the presence of markers in each of the zones differentiates between the various types. If more than 80 percent of the markers are evacuated, the study results are said to be normal. Slow transit constipation is qualitatively diagnosed if the markers are found scattered in the different zones[27]. If more than 50% of the markers are confined to one of the zones, it becomes segmental delay[28].

Qualitative assessment is necessary to determine the need for further X-rays in the study.

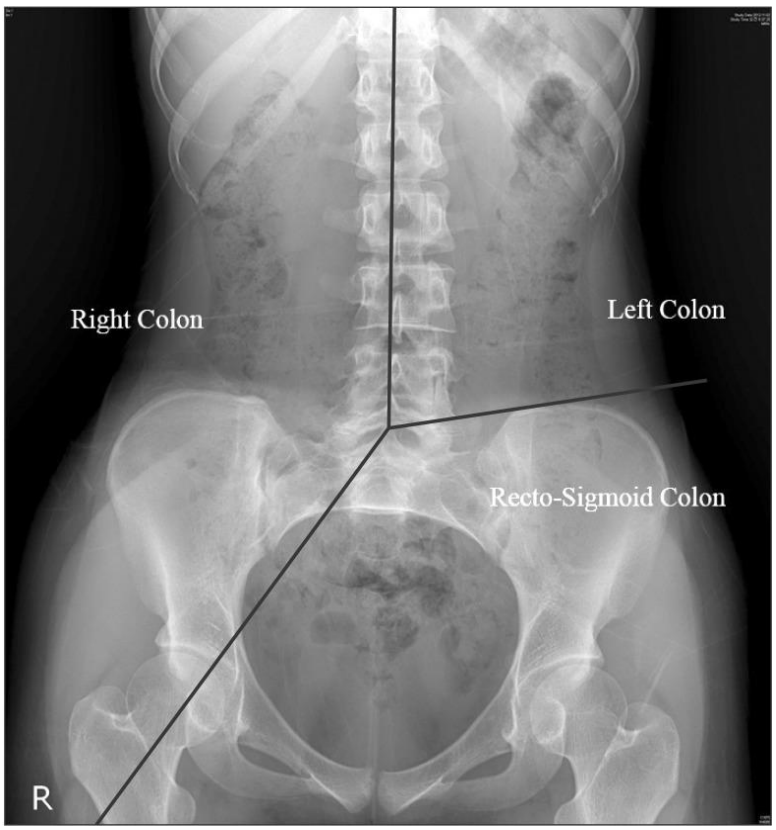

Fig1: Segmental division of Colon for CTT

Quantitative assessment measures the total and segmental colon transit in hours. Transit time is calculated by a specialised formula. The total number of markers in each colon segment or the entire colon is divided by a constant. The constant is obtained by dividing the time interval between the ingestion of capsules[in hours] by the total number of markers in each capsule[29]. For example, in the common method whereby the child consumes one capsule containing 20 markers every day, the constant is 1.2 [24/20]. However, this formula cannot be used if the child did not evacuate all the markers in 3 days. Therefore, there is the need for another X-ray[29].

Various studies have established the normative values of colon transit time in children. Park (2004) has described a CTT with 3.1±4.2 [mean±SD]hours for right colon, 5.1±4.9 [mean±SD] hours for left colon and 7.4±4.9[mean±SD] hours for rectosigmoid region for children in the age of 2-10 years[26]. Wagener defines a CTT of 5.5±4.4[mean±SD] hours for the ascending, 10.9±9.6[mean±SD] for the

transverse and 6.1±5.4[mean±SD] hours for the descending for children between 4 and 15 years[30]. Another study published by Gutierrez et al explains a CTT of 29.08±8.3 hours with 7.25±5.75[mean±SD], 6.6±6.2[mean±SD] and 14.96±8.7[mean±SD] hours respectively for right, left and rectosigmoid colon[31]. The same study has also proved that age and gender has an effect on the CTT among children between the age of 2 and 14 years[31].

4.LIMITATIONS

Even though the marker studies are cheap and easily accessible, there is a higher risk of exposure to radiation with children than adults when the body surface area is considered. Also, the motion dynamics of markers is different from that of the faeces making the diagnosis different[23]. The diagnosis can vary between experts as there is interobserver variability. Moreover, the formula used to calculate the CTT may not always be the same when the circumstances are taken into consideration[23]. The compliance of patients can affect the study results as well. The study protocols differ from centre to centre.

When error count of the radio-opaque markers was considered, there was preference on barium suspension over X-rays as identified by 2 studies. However, as the searches done for this study comprise of selected databases and time periods, meta-analyses on the same might bring possible alternatives.

Although, this is the current scenario, marker studies still prove to be one of the best available first line investigation especially with regard to the assessment of constipation.

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