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ORIGINAL RESEARCH

Evaluation of role of mannitol, water and iodinated contrast as endoluminal contrast agent in bowel analysis on computed tomography

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Abstract

Introduction: The small and large bowel remains the most challenging area of gastrointestinal tract to examine for surgeons and gastroenterologists due to its length, caliber and overlap of loops. Gastro-intestinal tract is generally evaluated with radiography, ultrasound (USG), computed tomography (CT) and magnetic resonance imaging (MRI).

Objectives: To assess the role of mannitol, water and iodinated contrast as luminal agent in evaluation of bowel. Quantitative and qualitative bowel analysis using mannitol, water and iodinated contrast agent.

Methods: 150 patients referred to our department for various abdominal pathologies. These patients were divided into three groups randomly and given mannitol, positive oral contrast and plain water as endoluminal contrast agent. The examination was done using SIEMENS SOMATOM Definition AST, 128 slice CT scan with CPT software with MEDRAD STELLANT 105.2_SH pressure injector in our department over a period of 18 months.

Results: Mannitol as endoluminal contrast agent causes better bowel distension, mural fold visibility, homogeneity of intraluminal content with lesser artifacts and overall better image quality.

Conclusion: Computed tomography (CT) enterography using mannitol is excellent technique in better visualization of small bowel loops and helped to provide better diagnosis for intestinal abnormalities.

Introduction

The small and large bowel remains the most challenging area of gastrointestinal tract to examine for surgeons and gastroenterologists due to its length, caliber and overlap of loops. Due to the complexity and long length of these bowel loops, the clinical diagnosis towards the bowel diseases always had the great challenges.(1) For that reason, computed tomography is indicated for proper evaluation of intestine. (2) Gastro-intestinal tract is generally evaluated with radiography, ultrasound (USG), computed tomography (CT) and magnetic resonance imaging (MRI). (3) Other modalities has a lesser role in the assessment of intestinal pathologies due to artifacts due to bowel peristalsis and air.(1)It had also been widely used in the inspection of other intestinal diseases such as intestinal ischemia, unexplained gastrointestinal bleeding and intestinal tumors, etc (9)(10). Optimal bowel preparation, distension, acquisition and fold visualization are prerequisite to improve the success of accurate interpretation of various bowel pathologies.The CT enterography, which used the oral administration of neutral contrast agent combined with the intravenous iodine contrast agent, could clearly show the details of intestinal walls, because it was convenient and non - invasive, thus it was easy to be accepted by the patients and the clinicians.(11)(12)(13)A

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proper oral contrast agent causing uniform intra-luminal attenuation, high contrast between luminal content and bowel wall also having minimal mucosal absorption leading to maximum distension, absence of artifact formation and no significant adverse effects should be used. (15)This study aimed to evaluate the abilities of three MDCT luminal contrast agents that include water, mannitol solution and diluted iodinated contrast to assess the efficacy in improving bowel distension, fold visualization, and intra-luminal contrast homogeneity.

Aims and objectives

- To assess the role of mannitol, water and iodinated contrast as luminal agent in evaluation of bowel.
- Quantitative and qualitative bowel analysis using mannitol, water and iodinated contrast agent.

Material and methods

A present study was done at the department of Radiodiagnosis of the tertiary care centre. Patients with h/o vomiting, abdominal distension, constipation were included. Detained history of patients including name, age, sex, habits, chief complaints with detailed clinical examination was taken. All the patients were kept fasting for atleast 6 hours prior. Study was done with clearance from ethical committee.

Inclusion criterion

Patient between age group 25 to 70 years. Patients between 25 to 70 years referred to department of Radiology in our institute for CT abdomen for various indications were included in study.

Exclusion criteria

All patients who did not give consent to be a part of the study. Patient with suspected intestinal obstruction. All patients having h/o adverse reaction to the contrast agent used.

Contrast media used

Nonionic water soluble Iodinated contrast, Mannitol, Water.

Machine

The examination was done using **SIEMENS SOMATOM Definition AST, 128 slice CT scan** with **CPT software with MEDRAD STELLANT 105.2_SH pressure injector** was used. The imaging system is enclosed in a CT gantry room.

Statistical analysis

The data obtained was coded and entered into Microsoft Excel Worksheet (Annexure III). The categorical data was expressed as rates, ratios, proportions and percentages. ANOVA test, Tukey's test and Chi square test were used for quantitative and qualitative analysis of bowel on CT. . Pair wise comparison of bowel loops done by using Tukey's test.

Results and discussion

In this study we observed that with the recent advent of MDCT, increase in contrast and spatial resolution of images had helped in better visualization of small bowel loops and thus helped to provide better diagnosis for intestinal abnormalities. Horton KM1, Fishman EK (1) also concluded in their study that CT played a more important role in evaluation of small bowel neoplasm and further thinner collimation possible with multi-detector CT (MDCT) along with water as oral contrast and a good intravenous contrast bolus may improve the

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sensitivity of CT for detecting small bowel tumors. (1) This conclusion was also supported a study done by ***Macari M et al***.(68)

- **Role of endo-luminal contrast agent in visualization of small bowel**

  The bowel loops are an anatomically and biomechanically complex intra-abdominal organ. In our study of 150 patients, 50 patients were given mannitol in water, 50 patients were given plain water and 50 patients consumed positive contrast in water. We observed that endo-luminal contrast is needed for optimal visualization of small bowel.***Furukawa A1 et al*** (51) and ***Tochetto S1 et al*** (56) also had similar conclusion stating that to acquire images of diagnostic quality, administration of a fairly large amount of intra-luminal contrast agent prior to examination and scanning with intravenous contrast material injection are necessary.(51) (56)

- **Quantitative analysis of bowel loopsfor distension of the bowel loops**

In our study quantitative analysis of bowel loops was done to look distension of bowel loops and mural fold visibility. Variable amount of distension of bowel loops was seen with all the three endo-luminal agents. Mean jejunal distension with mannitol was 2.15 +/- 0.33 cm, with plain water was 1.39 +/- 0.05 cm and with positive contrast in water was 1.98 +/- 0.12 cm. Mean ileal loops distension with mannitol was 3.38 +/-0.667 cm, with plain water was 1.38 +/- 0.490 cm and with positive contrast in water was 2.08 +/-0.274 cm. Mean ileo-cecal junction distension with mannitol group was 3.34 ± 0.73 cm, with plain water group was 1.96 ± 0.21 cm and with positive contrast group was 2.3 ± 0.43 cm.There was significant difference in distension of bowel between three groups. Thus it was concluded that Distension of bowel was highest in mannitol in water > positive contrast in water > plain water. These findings corresponds to the study done by ***K prakashini, ChandanKakkar et al.*** (2)The objective of study was to assess the performance of mannitol as a luminal contrast as compared to water and positive contrast in evaluation of bowel on multi-detector computed tomography. Mannitol showed better results for small bowel distension on quantitative and qualitative analysis with better ileo-caecal junction distension and mural feature visibility. Visualization and distension of IC andColon with mannitol solution was unparalleled as compared to plain water or positive contrast agents due to its rapid transit and non-absorbable nature. Water showed suboptimal distension, predominantly in the distal bowel loops due to its rapid absorption by the bowel mucosa. Adequate distension was observed with positive contrast media also; however, loss of mucosal details was encountered. Thus this study showed the results as mannitol as bestendo-luminal contrast.(2)

- **Quantitative analysis of bowel loopsfor mural fold visibility**

Detailed mural fold features and fold visibility were assessed in these three groups. Out of the 50 subjects those consumed mannitol as endo-luminal contrast agent, Grade II mural fold visibility was seen in 24 patients (48 %), grade I mural fold visibility was seen in 24 patients (48 %) and only two patients (4 %) showed grade 0 mural fold visibility. In positive contrast group, out of 50 patients, Grade I mural fold visibility was seen in 30 patients (60 %) and grade 0 mural fold visibility was seen in 20 (40 %). In water group out of 50 patients, 29 patients (58 %) were classified as grade I mural fold visibility and 21 patients (42 %) were classified as grade 0 mural fold visibility. It was observed that mural fold visibility was better delineated by mannitol as compared to positive contrast and water. There was significant statistical p value difference between mannitol group and rest of the two groups that is plain water and positive contrast in water group. (Statistical p value was < 0.001). Our study correlated with a study done by ***Megibow AJ1 et al*** (53) which observed that oral

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administration of negative contrast agent provided excellent distention and excellent visualization of mural features in the gastrointestinal tract.(53)

- **Qualitative analysis of bowel loopsforOverall Image Quality, Bowel distention and homogenity**

Qualitative analysis of small bowel loops was done for wall visibility, bowel distention, homogeneity of intra-luminal contents and overall Image quality. Qualitative analysis was based on three point scoring system Score I to Score III. Out of 50 patients those given the mannitol in water as endo-luminal contrast agent, 23 patients (46 %) showed score II, 24 patients (48 %) showed score I and 3 patients (6 %) showed score 0. Out of 50 patients those consumed water as endo-luminal contrast agent, 26 patients (52 %) showed score I and 24 patients (48 %) showed score 0. Out of 50 patients those consumed positive contrast in water as endo-luminal contrast agent 35 patients (70 %) showed score I and 15 patients (30 %) showed score 0. It was observed that wall visibility, bowel distention, homogenity of intra-luminal contents and overall Image quality was better delineated by mannitol as compared to positive contrast in water and plain water. The significant p-value difference noted between the three groups. (statistical p value was < 0.001). Similar findings also seen in study done by ***Megibow AJ1 et al.*** He concluded that oral administration of negative contrast agent provided excellent distention and excellent visualization of mural features in the gastrointestinal tract.(53)Our study correlates with the study by ***K Prakashini et at*** (2) and***Padhmanabanelamparidhi et al***(3)which concluded that 56% of patients given mannitol had excellent distention and fold visibility.

- **Presence of artifacts**

Presence of artifacts due to endo-luminal contrast agents was assessed in this study. It was observed that no artifacts seen with water and mannitol as endo-luminal contrast agent. While out 50 patients those consumed positive contrast, 15 patients (30 %) showed some amounts of artifacts.

- **Comparison of distension of bowel with mannitol, water and positive contrast group :(Axial CT venous phase images.)**

Figure 1 : Mannitol group

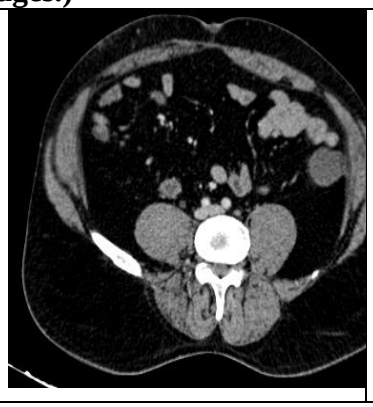

Figure 1 : Water group

Figure 1 : Positive contrast

- **Comparison of mural fold visibility of bowel loops between three group. : (Axial CT venous phase images.)**

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Figure 2 : Mannitol group **Figure 2 : Water group** **Figure 2 : Positive contrast**

- **Comparison of qualitative analysis of bowel loops between three group. :(Coronal CT venous phase reformatted images.)**

Figure 3: Mannitol group **Figure 3 : Water group** **Figure 3 : Positive contrast**

Conclusion

Recent advent of MDCT, increase in contrast resolution of images is helpful in better visualization of small bowel loops and thus helped to provide better diagnosis for intestinal abnormalities. Computed tomography (CT) enterography using mannitol is excellent technique in better visualization of small bowel loops and thus helped to provide better diagnosis for intestinal abnormalities. Small bowel distention, bowel homogeneity, mural fold features and overall image quality is better with mannitol than other two contrast agents i.e. positive contrast in water and plain water. Mannitol should be preferred as endo-luminal contrast agent for bowel. Thus CT enterography with iso-osmotic mannitol as orally administered negative contrast is a simple, noninvasive, effective and economic method for assessing small bowel diseases and others to provide better diagnosis for intestinal abnormalities.

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