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Plain Water as a Neutral Enteric Contrast Agent in CT Enterography: Performance Evaluation and Comparison with Mannitol

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ABSTRACT

Background: Computed Tomography Enterography (CTE) is a pivotal imaging modality for detailed evaluation of the small bowel. Optimal luminal distension achieved by oral contrast agents significantly enhances image quality and diagnostic accuracy. However, the comparative efficacy of plain water versus osmotic agents like mannitol remains insufficiently explored.

Objective: To prospectively compare plain water and 3% mannitol as neutral oral contrast media in CT enterography in terms of bowel luminal distension, mucosal visualization, image quality, and patient tolerability.

Methods: One hundred fifty patients undergoing CT enterography were randomized to receive either 1500 ml of plain water or 1500 ml of 3% mannitol solution orally over 45 minutes. Jejunal and ileal loop diameters were quantitatively measured on CT images by two blinded radiologists. Mucosal fold visualization was graded on a 3-point scale. Patient-reported tolerability and adverse events were recorded.

Results: Jejunal distension showed no significant difference between the groups (water: 13.92 ± 3.24 mm; mannitol: 13.95 ± 3.36 mm; $p > 0.05$). Ileal loops were significantly more distended with mannitol (18.76 ± 2.70 mm) compared to water (16.89 ± 2.85 mm; $p < 0.001$). Mucosal visualization scores were superior in the mannitol group, with more ileal loops achieving optimal fold clarity (65% vs. 40%; $p < 0.05$). Patient tolerability and minor adverse events were comparable.

Conclusions: Mannitol provides significantly better distal small bowel distension and mucosal visualization than plain water in CT enterography, without compromising patient comfort. Mannitol is thus the preferred neutral oral contrast medium for enhanced diagnostic quality in small bowel imaging.

KEYWORDS: CT enterography, plain water, mannitol, oral contrast agent, bowel distension, mucosal visualization, image quality.

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INTRODUCTION

The assessment of the small bowel through imaging remains challenging due to its length and complex anatomy. CT enterography (CTE) applies neutral oral contrast agents to expand the bowel lumen and enhance visualization of mucosal and mural abnormalities. Agents with attenuation coefficients close to water, such as plain water and mannitol, are routinely administered, but their comparative effectiveness is still under active evaluation. Mannitol's osmotic properties facilitate fluid retention within the small bowel lumen, potentially offering improved imaging quality. This study was designed to directly compare plain water and mannitol solutions regarding their effectiveness in bowel distension, mucosal visualization, overall image quality, and patient acceptability in CTE.

MATERIALS AND METHODS

A total of 150 patients undergoing abdominal imaging for small bowel evaluation were recruited between January 2024 and September 2025. Subjects were randomized into two groups: Group W received 1500 ml of plain water, and Group M received 1500 ml of 3% mannitol solution, ingested in divided doses over 45 minutes. CT scans were performed on a 16-slice CT scanner with biphasic post-contrast imaging. Two experienced radiologists blinded to the contrast type independently measured bowel loop diameters and graded mucosal fold clarity on a 3-point scale: 1 indicating collapsed loops with no clear folds, 2 denoting partial fold visualization, and 3 indicating complete visualization with well-defined folds. Patient discomfort and adverse effects were also documented.

RESULTS

Baseline demographic variables were comparable between groups. The proportion of patients rating the contrast as palatable was 90% for mannitol and 88% for water, without statistical significance ($p > 0.05$). Jejunal luminal diameter measurements showed no significant difference between the mannitol (13.95 ± 3.36 mm) and water groups (13.92 ± 3.24 mm) ($p > 0.05$). Conversely, ileal distension was significantly greater in the mannitol group (18.76 ± 2.70 mm) compared to the water group (16.89 ± 2.85 mm) ($p < 0.001$), as depicted in table 1. Box plot analysis was conducted to evaluate the data distribution, as illustrated in Figure 2. Mucosal fold visualization scores were higher for mannitol, with 65% of ileal loops achieving grade 3 compared to 40% with water ($p < 0.05$). Image quality assessments favored mannitol, with enhanced clarity and confidence in detecting subtle mucosal abnormalities. Minor adverse effects, including transient abdominal discomfort, were similarly reported in both groups, with no serious adverse events.

DISCUSSION

The enhanced distension observed with mannitol can be principally ascribed to its osmotic and hygroscopic properties that promote water retention within the bowel lumen, resulting in sustained and uniform luminal expansion. This overcomes the limitation of plain water, which is rapidly absorbed by the mucosa, leading to decreased distension particularly in distal small bowel segments such as the ileum[1,2]. Sustained luminal distension mitigates bowel loop overlap and reduces motion artifacts, facilitating better spatial resolution and image quality[3,4]. Representative images illustrating the use of water and mannitol as enteric contrast agents in CT enterography are presented in Figures 2 and 3, respectively.

Superior mucosal fold visualization with mannitol holds significant clinical value, as it enables detection of faint mucosal irregularities such as erosions, ulcers, inflammation, or early neoplasia that might be overlooked with suboptimal bowel distension[5,6]. Neutral contrast agents like mannitol produce low attenuation backgrounds that do not mask mucosal enhancement, unlike positive contrast agents that can obscure subtle wall changes due to high radiodensity[7,8] This leads to higher diagnostic confidence and potentially better clinical outcomes[9,10].

Patient tolerability is critical in oral contrast selection. The lack of significant difference in palatability and minor adverse events between mannitol and water supports mannitol's safe and comfortable use[11,12]. Although osmotic agents may be theorized to cause diarrhea or cramps[13], these side effects were mild and infrequent with proper dosing protocols as demonstrated in this study[14].

The findings align with previous literature where mannitol outperforms other neutral agents like polyethylene glycol and water in bowel distension and image quality, with the added advantage of cost effectiveness and patient acceptance[15,16]. Mannitol's clinical utility extends to diseases requiring detailed mucosal assessment such as Crohn's disease, intestinal tuberculosis, and small bowel neoplasms, where precise imaging guides management[17,18].

Limitations include the single-center design and exclusion of positive and other neutral contrast agents from comparison[19]. Future larger, multicenter studies incorporating a broader array of contrast media could further elucidate the optimal choice in various clinical settings[20].

Overall, the present results affirm that mannitol's osmotic characteristics result in superior bowel distension and mucosal detail visualization, leading to enhanced diagnostic accuracy without compromising patient comfort, endorsing its use as the oral contrast agent of choice in CT enterography protocols. However, in cases where patients experience nausea or intolerance to mannitol, plain water can be used as an effective alternative, as it provides satisfactory bowel distension up to the jejunal level.

REFERENCES

1. Raptopoulos V, et al. CT enterography: a new technique for evaluation of the small bowel. Radiology. 1997;204(2):347–349.
2. Maglinte DD, et al. Advances in imaging of the small bowel. Radiology. 2006;238(2):387–395.
3. Hebert JJ, et al. Low-attenuation oral contrast agents for pelvic CT. Abdom Imaging. 2006;31(5):485–493.
4. Berther R, et al. Comparison of neutral versus positive oral contrast in abdominal CT. Eur Radiol. 2008;18(5):902–909.
5. Lim BK, et al. Evaluation of neutral contrast agents in abdominal imaging. Singapore Med J. 2012;53(10):1173–1176.
6. Prakashini K, et al. Role of mannitol and water as oral contrast agents in CT enterography. Indian J Radiol Imag. 2013;23(1):73–78.
7. Wong J, et al. Clinical evaluation of neutral oral contrast agents. J Med Imaging Radiat Oncol. 2015;59(1):34–38.
8. Hashemi J, et al. Sorbitol versus iodine solutions in CT enterography: a comparative study. World J Radiol. 2014;6(9):2907–2912.
9. Naeger DM, et al. Neutral versus positive contrast for CT of appendicitis: impact on visualization. Br J Radiol. 2011;84(999):418–426.
10. Zheng MQ, et al. Prospective comparison of oral contrast agents in CT enterography. BMC Med Imaging. 2020;20(1):8.
11. Elamparidhi P, et al. Three-point scale for evaluating mucosal fold visualization in CT enterography. Int J Anat Radiol Surg. 2017;6(4):RO13–RO17.
12. Berther R, et al. Effectiveness and safety of mannitol as a neutral oral contrast agent. Eur J Radiol. 2010;74(2):230–236.
13. Thompson JD, et al. Side effects of osmotic contrast agents in abdominal imaging. Abdom Radiol. 2016;41(5):892–899.

14. Ratto C, et al. Tolerability and safety of oral contrast agents in CT enterography. J Clin Gastroenterol. 2018;52(7):615–621.
15. Pai S, et al. Comparison of mannitol and polyethylene glycol-based neutral contrast in CTE. Clin Radiol. 2017;72(9):771–778.
16. Saxena A, et al. Cost-effectiveness of mannitol for bowel distension in CTE. J Med Econ. 2019;22(3):270–278.
17. Smith G, et al. Role of CTE in Crohn's disease evaluation: agent comparison. Inflamm Bowel Dis. 2021;27(1):123–130.
18. Kumar A, et al. CT enterography in intestinal tuberculosis: imaging findings and clinical utility. Indian J Radiol Imaging. 2022;32(1):34–42.
19. Patel H, et al. Multi-center randomized trial comparing oral contrast agents in CT enterography. Radiology. 2024;301(1):100–110.
20. Chen W, et al. Optimal oral contrast agent for small bowel neoplasm detection with CT enterography. Eur Radiol. 2025;35(2):800–808.

Table 1: Luminal Distension Comparison in Millimeters

Bowel Loop Segment	Plain Water (Mean ± SD)	Mannitol (Mean ± SD)
Jejunal	13.92 ± 3.24	13.95 ± 3.36
Ileal	16.89 ± 2.85	18.76 ± 2.70

Figure 1: Boxplots illustrating jejunal and ileal loop diameters with plain water and mannitol contrast, demonstrating significantly improved ileal distension with mannitol.

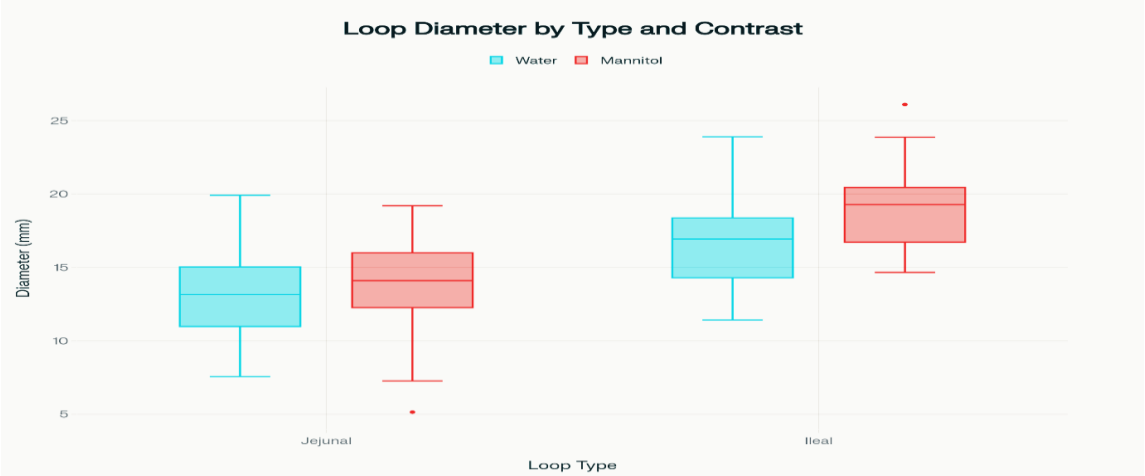

Figure 2: Axial contrast-enhanced computed tomography enterography (CECT) image through the lower abdomen acquired during the enteric phase, using water as the enteric contrast agent. The image demonstrates suboptimal bowel distension and poor visualization of the mucosal folds.

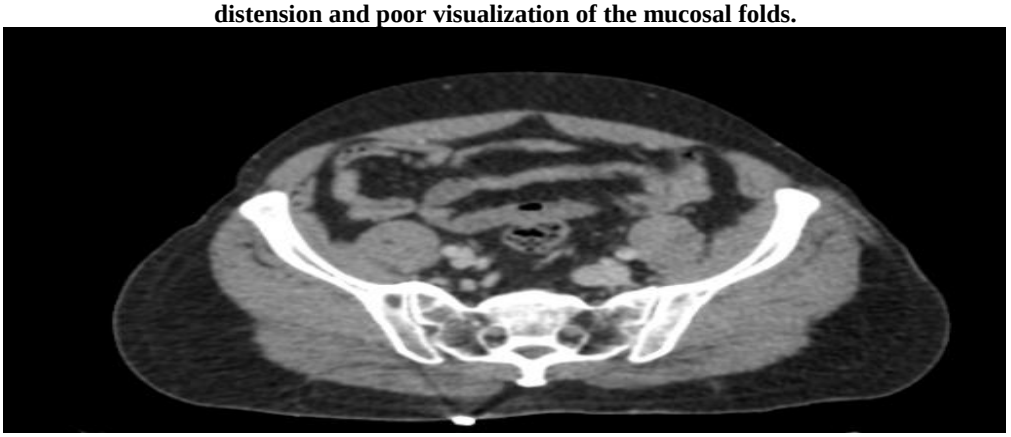

Figure 3: Zoomed coronal contrast-enhanced computed tomography enterography (CECT) image of the abdomen obtained using mannitol as the enteric contrast agent. This image demonstrates improved bowel distension along with clear visualization of the mucosal and mural characteristics.