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Efficacy of 3% sorbitol solution in preparation to magnetic resonance enterography in children with inflammatory bowel disease

Skuteczność 3% roztworu sorbitolu w przygotowaniu do enterografii rezonansu magnetycznego u dzieci z nieswoistym zapaleniem jelit

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None

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Summary

Introduction. To successfully perform MR enterography technique the distention of the small bowel is necessary. However, there is no guidelines of bowel preparation.

Aim. To detect efficacy in bowel distention of 3% sorbitol solution as contrast for MR enterography in children with IBD.

Material and methods. 58 patients, who had magnetic resonance enterography, were included. Amount of 3% sorbitol solution for enterography depended on children's age. The bowel preparation had been started 2 hours before examination. Children younger than 12y old were recommended to drink solution composed of 35 ml 3% sorbitol mixed in 200 ml water. Older drank 45 ml in 200 ml water and 50 ml in 200 ml water for 12-15y old and older than 15y old, respectively. After that in every 10-15 min they were drink water to fulfil small bowel.

Results. 7/58 (12%) patients presented intolerance to sorbitol solution. 4 (6.9%) experienced vomiting, 3 (5.3%) had diarrhoea after contrast adjustment. As a result of severe vomiting in case of 1 patient MR was not performed and for another one study was stopped. Segmental, not sufficient small bowel distention were observed in 21.1% and in 17.5% cases MR showed lesions suggested inflammation which could be false positive results. There was found strong statistically significant correlation between these two variables. However, magnetic resonance enterography in 94.8% has shown good distention of terminal ileum.

Conclusions. Generally, bowel preparation for magnetic resonance enterography was good tolerated. *Ileum terminale* was successfully evaluated in 94.8%. However, for 21.1% cases segmental insufficient small bowel distention was observed.

Streszczenie

Wstęp. W celu prawidłowego przeprowadzenia badania enterografii rezonansu magnetycznego wymagane jest odpowiednie rozdęcie pętli jelita cienkiego. Aktualnie brak jest schematu przygotowania do badania MR.

Cel pracy. Ocena skuteczności w poszerzeniu pętli jelita cienkiego po zastosowaniu 3% roztworu sorbitolu w przygotowaniu do enterografii rezonansu magnetycznego u dzieci z nieswoistym zapaleniem jelit.

Materiał i metody. Do badania włączono 58 pacjentów, którzy mieli wykonane badanie enterografii rezonansu magnetycznego. Przygotowanie jelita rozpoczęte było na 2 godziny przed badaniem. Ilość roztworu 3% sorbitolu jaką musiało wypić dziecko, uzależnione było od jego wieku. Dzieci poniżej 12. r.ż. miały do wypicia roztwór złożony z 35 ml 3% sorbitolu rozpuszczonego w 200 ml wody. Starsze dzieci wypijały odpowiednio dla przedziału wiekowego 12.-15. r.ż. lub powyżej 15. r.ż.: 45 ml w 200 ml wody oraz 50 ml w 200 ml wody. Następnie, aby uzyskać odpowiednie rozdęcie pętli jelita cienkiego, co 10-15 min dopijały wodę.

Wyniki. 7/58 (12%) pacjentów prezentowało objawy nietolerancji po wypiciu roztworu sorbitolu. 4 dzieci (6,9%) wymiotowało, u 3 (5,3%) obserwowano biegunkę. W wyniku

uporczywych wymiotów u jednego pacjenta badania nie wykonano, a w przypadku drugiego dziecka badanie zostało przerwane. Odcinkowe, nieodpowiednie poszerzenie pętli jelita cienkiego było obserwowane u 21,1%, a w 17,5% przypadków badanie MR wykazało zmiany sugerujące zmiany zapalne, co mogło być jednak wynikiem fałszywie dodatnim. Odpowiednie rozdęcie *ileum terminale* uzyskano u 94,8% pacjentów.

Wnioski. Przygotowanie jelita do enterografii rezonansu magnetycznego generalnie było dobrze tolerowane. W 94,8% uzyskano odpowiednie rozdęcie *ileum terminale*. Jednakże u 21,1% pacjentów obserwowano odcinkowe niewystarczające rozdęcie pętli jeli-towych.

INTRODUCTION

Inflammatory bowel disease (IBD) includes Crohn's disease, ulcerative colitis, and indeterminate colitis. Historically, diagnosis of IBD based on endoscopy and conventional X-ray barium studies. The main disadvantage of the latter was exposition of patients on ionizing radiation. Recently the number of incidences of IBD in children and adolescents is on the rise (1). More frequently is observed severe form of disease which need to evaluate treatment effects. To avoid exposure to undesirable studies effects, in search were new techniques which will characterize with high effectiveness in detection of bowel inflammation, high safety profile and repetitiveness. Introduction of cross-sectional imaging replaced fluoroscopic studies in many centers. Especially popular is magnetic resonance (MR). The most important feature is the lack of ionizing radiation. Similarly as computed tomography (2), MR is characterized by high specificity and sensitivity in detection of IBD lesions localized in small bowel. Actually MR technique is considered as the study of choice to detect inflammatory bowel disease lesions in gut localization (3). Presence of gut inflammation seen in MR is helpful to differentiate both IBD entities. Furthermore magnetic resonance is taking a part in therapeutic process. High disease activity can require more aggressive pharmacological treatment. MR image is helpful to plan range of surgery if is needed. Farther, MR can be successfully used to assess efficacy after pharmacological treatment or to detect disease recurrence after bowel resection. MR can efficiently detect extraluminal manifestations of IBD (4). Thus diagnostic imaging by MR is used not only at initial diagnosis, but also to monitor response to therapy, to search extraintestinal complications or plan operative management.

Magnetic resonance can be performed in two forms: enteroclysis and enterography. Methods differ to each other by the way how the patient is prepared for the study, namely the method of administration the contrast agent used to fulfill small bowel. Optimal luminal distension is a key to diagnostic imaging of the small bowel. Enteroclysis is a technique when contrast agent is delivered via a nasojejunal tube. Optimum bowel distension is successfully obtained by this method. Although it is effective, this is relatively uncomfortable for patients. Placement of nasojejunal tube is unpleasant or sometime even painful. Further-

more, position of tube should be checked by X-ray what entail exposure to ionizing radiation. As IBD are long-life diseases requiring several imaging examinations for therapeutic monitoring, such ionizing exposure should be avoided especially for young patients. In 2001 non-invasive distension of small bowel was proposed by oral contrast ingestion (5). Comparative studies showed that optimal bowel distension was achieved better by enteroclysis than enterography (oral contrast administration), but both methods are characterized by high diagnostic accuracy (6). Analysis performed among adult patients which point was to assess tolerance on way of contrast agent administration showed that oral method was more preferable (7). Up to now, is only few experiences with MR-enteroclysis in children. There is no evidence of better results with use of MR-enteroclysis than MR-enterography. However, it seems that for children more common is to perform MR enterography, especially because can totally avoid exposition for ionizing radiation (8). Unfortunately, still there are no guidelines for the required type and dose of contrast, neither timing of administration and imaging. Because lack of recommendations to bowel preparation before MR, in search is type of the most optimal substance (9-12). The best contrast agent should be tasty, easy to administer (preferably needed to drink small amount of contrast solution), should have minimal mucosal absorption, and not cause of artifacts. Additionally it should have low cost and do not cause side effects.

AIM

The aim of our study was to assess efficacy in bowel preparation with use of 3% sorbitol solution. Presence of any adverse effect were recorded.

MATERIAL AND METHODS

The group of 58 patients, who had magnetic resonance enterography, were included to the study. They were 21 girls and 37 boys. Mean age were 14.31 (min 7.76-max. 17.92y). Indication for MR enterography were suspicious of IBD or as control study in previously confirmed disease. Children with history of surgery intervention, resection any part of small bowel were excluded from the study. All children were obligatory to stay without eating and drinking at least 4 hours before the study. Patients started bowel preparation 2 hours before imaging. In case of all participants, contrast agent was administered orally. Amount of 3% sorbitol

solution for enterography depended on children's age. Children younger than 12y old were recommended to drink 35 ml 3% sorbitol mixed in 200 ml water. Older patients drank 45 ml in 200 ml water and 50 ml in 200 ml water for 12-15y old and older than 15y old, respectively. After that patients were asked to drink every 10-15 min clean water to properly fulfil small bowel. Finally children were obligatory to drink in total 1200-1500 ml of contrast solution. Because very sweet taste of sorbitol, optionally were possibility to add the lemon juice. Study was recognized as successful, if optimal distention of terminal ileum was achieved.

RESULTS

In total 7/58 (12,1%) patients presented intolerance to sorbitol solution. 4 (6.9%) experienced vomiting, 3 (5.2%) had diarrhoea after contrast adjustment (fig. 1). As a result of severe vomiting in case of 1 patient MR was not performed and for another one study was stopped. Segmental, not sufficient small bowel distention were observed in 21.1 and in 17.5% cases MR showed lesions suggested inflammation which could be false positive results. There was found strong statistically significant correlation between these two variables. However magnetic resonance enterography in 94.8% shown good distention of terminal ileum enabled proper visualisation.

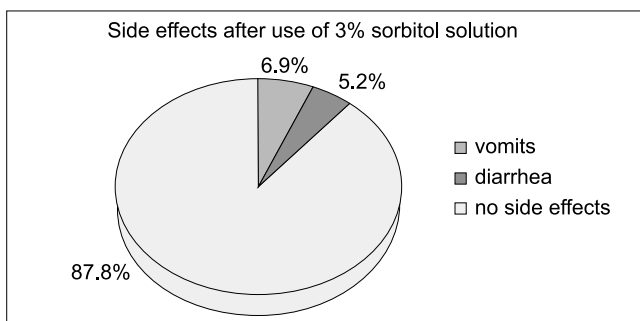


Fig. 1. Side effects after use of 3% sorbitol solution

DISCUSSION

To assess small bowel by magnetic resonance technique is crucial to sufficiently distend the gut. Only proper distension provide reliable results. Nonsufficient bowel distension can result that some bowel segments will collapse. Collapsed bowel loops can give the false appearance of wall thickening what in consequence can give false positive results. On the other hand because not optimal loops distention, inflammatory lesions can be hidden, thus not sufficient distension can cause to overlook IBD lesions (13).

Among contrast agents used in MR technique are distinguishable 3 types: positive, biphasic and negative contrast solutions. Positive contrast agents have high signal on T2- and T1-weighted images. In this

group are manganese chloride, ferrous ammonium citrates, gadolinium chelates etc. Biphasic agents like polyethyleneglycol (PEG), osmotic carbohydrate sugar alcohols such as sorbitol and mannitol, water, methylcellulose, locust bean gum (LBG) characterized low signal on T1- and high on T2-weighted images. Last group named negative contrast agents consist perfluorooctyl bromide, ferumoxide ect. They are characterized by hypointense in T1- and T2-weighted sequences (13, 14). Biphasic contrast agents are the most commonly used to assess small bowel. Among them in view of contrast proprieties, water was supposed to be optimal substance. Other advantages were that is commercially available and inexpensive. Unfortunately, because of rapid physiological absorption water did not sufficiently distend distal part of ileum (15, 16). Some centers use water in case if other contrast agent is not tolerated (17). It was necessary to use additives which will prevent or delay the absorption of water. To this purpose is common to use, mannitol, VoLumen, sorbitol, polyethylene glycol, locust bean gum (18). Mannitol for long time have been used for bowel cleansing before colonoscopy. However higher mannitol concentration is associated with higher incidence of side effects. The most common symptom is diarrhea or abdominal spasm. Furthermore metabolism of mannitol results to produce potentially explosive gases (hydrogen and methane). VoLumen is a commercially available product developed to perform CT enterography. Contains water solution of barium with sorbitol (19). Sorbitol is carbohydrate. Sorbitol is substance widely used in pharmacological industry as take a part in production of sublingual and lozenge pills. Likewise is used in food industry as sweetener product. Metabolism of sorbitol is different as mannitol. Sorbitol is slowly absorbed by the small bowel and is metabolized to fructose, lactate and pyruvate (20). Majority of sorbitol can reach large bowel where it is metabolized by the bowel flora. Metabolic products are lactulose and acetic acid and lactate, which can results in side effect as diarrhea. Metabolic products does not form explosive gases as mannitol. Studies where was done comparison between mannitol and sorbitol solution, showed lower side effect with use latter contrast agent (21).

At literature, data of studies to assess efficacy of small bowel distension among inflammatory bowel disease patients are scarce. Most studies is showing comparison between contrast agents which was performed at healthy volunteers. It is not known how distension values differ with patients having small bowel pathology. Nevertheless searching for ideal contrast agent gives promising results. Is very common to make mixed solution where to water is added sorbitol and other biphasic agent. The combination of two biphasic contrast agents allows to use their lower concentration, thereby avoiding or minimalizing side effects. This kind of new contrast agent solution was used in study performed

to assess effect of the osmolarity for small bowel distension in MRI. Every healthy volunteer had performed MR study twice after use of different contrast solution. Comparison between a water solution combined with 2.0% sorbitol and 0.2% locus bean gum (LBG) with higher quantity (1500 ml) and an lower osmolarity, and at other examination a water solution combined with 2.0% sorbitol and 2.0% barium sulphate was done. Last contrast had lower quantity (1000 ml) and higher osmolarity. In results, similar bowel distention of both contrast agents was observed. Side effects were also similar, but bowel preparation was better tolerated by participants with use 1000 ml of sorbitol-barium sulphate solution (22). Other interesting results gave combination of sorbitol with locust bean gum solution. Study performed by Ajaj et al. showed the best distension of the small bowel after ingestion of water combined with LBG and 2.0% sorbitol. Higher concentration of sorbitol (2.5%) led to higher degree of diarrhea, vomiting and spasm (21).

Our study showed that use of 3% sorbitol solution enabled sufficient distention of terminal ileum in 94.8%. Ileum is supposed to be the most often site of Crohn's disease (23). Nevertheless from our patients around 21% patients had segmental not sufficient distention of earlier bowel loops. This could be caused by long time of bowel preparation. In comparison in study Sauer et al. (24) children started to drink contrast agent 90 min and in Dagia et al. (25), 60 min before imaging. In comparison of efficacy we detect better visualization of terminal ileum than was shown at study Saini et al. where authors compared efficacy of psyllium and sor-

bitol. Good and excellent ileum visualization was similar after both contrast agents and was achieved in 65%. Authors of mentioned analysis were not reported side effects (26). Because obstruction after use of psyllium seed husk were reported (27), sorbitol seems to be safer. Among Our patients 12% demonstrated sorbitol intolerance. Nevertheless in case of 2 patients (3.4%) study because of intensive side effect could not be performed.

Our study had several limitations. Firstly our analysis is retrospective. We were focused on efficacy and side effects. Because retrospective character we have not included tolerance and patient's experience in drinking large volume of this contrast agent. Comparison inflammatory lesions detected by MR with other technique were not proceeded.

CONCLUSIONS

MR enterography is the radiation-free technique. High efficacy in detection of IBD lesions and safe characteristics makes that in many centers, MR replaced the X-ray assessment of the small bowel. Important advantages is the ability to evaluate extraluminal disease. Optimal bowel distension is crucial to get the most sensitive result. Studies, which aim is to detect the best tolerated and sufficient method to small bowel preparation are highly important. Bowel preparation with use of 3% sorbitol solution for magnetic resonance enterography was generally good tolerated. *Ileum terminale* was successfully evaluated in 94.8%. However in 21.1% cases was observed segmental insufficient small bowel distention.

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