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Effect of mucous fistula refeeding in neonates with small bowel enterostomy at a low resource center- a prospective interventional study: a single center experience in a Bangladeshi pediatric surgical unit

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ABSTRACT

Aims: Neonates with small bowel enterostomy face substantial challenges in maintaining fluid balance, optimal nutrition and growth, especially in low- and middle-income countries (LMIC) where parenteral nutrition (PN) is not extensively available. Moreover, the discrepancy between proximal and unused distal loop often makes the anastomosis challenging and risky during closure. This study was aimed to describe a simple method of mucous fistula refeeding (MFR) in a resource constrained environment and to see the impact of MFR on growth and nutrition and distal intestine diameter.

Methods: A simplified MFR technique requiring minimal resources was employed, which was taught to and carried out by the caregivers. Distal loopogram was performed before commencement of MFR and before stoma closure. The weight gain and width difference of the distal loop at splenic flexure was measured. Statistical analysis was done in SPSS 26.0 and $p<0.05$ considered to be significant.

Results: We implemented MFR on ten consecutive neonates. The indications for enterostomy formation were meconium ileus (6), three among them were complicated, ileal atresia (3), and intestinal perforation (1). Mean rate of weight gain was 18 gm/day and mean gut width increment was 0.1 mm/day ($p < 0.05$). One patient (10%) had anastomotic leakage following stoma closure.

Conclusion: Mucous fistula refeeding is a safe method that can reduce nutritional complications and enhance growth, and reduce bowel lumen discrepancy, making the anastomosis safer during stoma closure.

Keywords: Small bowel enterostomy, mucous fistula refeeding, gut width, rate of weight gain, bowel lumen discrepancy

INTRODUCTION

Enterostomy is an essential procedure in pediatric surgery where patients are not in the condition to take the burden of anastomosis or the condition of the distal bowel are not favorable.[1] In complicated meconium ileus, intestinal atresia, necrotizing enterocolitis, bowel perforation, anastomotic leakage, temporary small bowel stoma becomes surgeon's choice for the safety of the patients.[2]

Though enterostomies are made as a safe procedure with the intention of avoiding mortality and morbidity of the patients, there are some potential complications for small bowel enterostomies.[3] Proximal high output small bowel stoma mimics as short gut syndrome and results in inadequate absorption of nutrients and electrolytes, leading to fluid imbalance, dehydration, malnutrition and failure to thrive, affecting growth, cognitive development and in severe cases survival.[4] Previous studies indicate that the prolonged impact of nutrient and fluid loss will lead to a decline in growth in the majority of young children with a stoma, prompting to recommend early stoma closure.[5]

To improve nutritional management in neonates, parenteral nutrition (PN) has gained widespread utilization in developed nations.[6] Though PN has a significant role in promoting growth and nutrition in the management of short gut syndrome, dependency on PN may cause PN related liver disease (PNALD), metabolic derangements and sepsis.[6,7] Besides, in developing countries, lack of availability, inadequate aseptic environment and the high expense makes PN a not accessible option.[8]

In children with enterostomy, when the distal bowel or mucous fistula no longer experiences direct exposure to the fecal stream, there is a concurrent decrease in contractility and smooth muscle tone in the mucous fistula.[9] Moreover, in cases of intestinal atresia, there is higher incidence of complications due to the persistent significant discrepancy between the proximal and distal unused gut.[10] The disuse atrophy results in distal and proximal bowel loop diameter discrepancy which increases the risk for anastomotic leak.[11]

Mucous fistula refeeding (MFR) or feeding enteroclysis or chyme recycling means transferring the proximal loop content into the distal loop, maintaining the normal pathway of chyme and utilizing the whole remaining gut length as absorptive surface. In recent decades, a growing number of centers have adopted the practice of MFR in the neonatal population.[12]

This intervention is believed to prevent atrophy of the inactive gut, promoting regular absorption and digestion of nutrients.[13] Additionally, it is thought to stimulate mucosal growth, support intestinal adaptation, and reduce the risk of anastomotic leaks.[11]

There have been several studies, mostly retrospective, performed in developed countries focusing on the effect of MFR on decreased requirement of PN, and a few review articles and one randomized control trial have proved the safety and efficacy of MFR.[7,12] There is no study available yet regarding the efficacy and safety of MFR in middle- and low-income setting. The aim of this study was to assess the outcome of MFR in our set up in a prospective trial.

METHODS

The study was carried out with the permission of Ethical Committe Bangladesh Shishu Hospital & Institute (Date: 25.10.2022, Decision No: BSHI/2022/2645). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This prospective intervention study was conducted in the Department of Pediatric Surgery at the Bangladesh Shishu Hospital & Institute from October 2022 to October 2023. Neonates with jejunostomy or ileostomy with mucous fistula managed at our Institution were eligible in the study. Distal obstruction, stenosis, multiple stomas or any anastomosis in the distal bowel were exclusion criteria from the study.

After taking informed consent from the parents, patients with small bowel stoma created at our unit or referred to us after stoma creation, were included in the study. Each patient was thoroughly examined, investigated and all relevant information was noted. The data was recorded in pre-designed, semi-structured questionnaire (supplementary material).

MFR was commenced when patient was on oral feed and could manage hydration and electrolyte balance without any parenteral support. Technique was taught to the caregivers. Proximal loop effluent was collected in a customized ostomy pouch. This was either made by a polybag attached with strips of cloth on both ends and tying this around, or by making a hole in wraparound cloth and adjusting a condom into it over the stoma (**Figure 1A, 1B**). If the effluent was thick, mixing it with normal saline was suggested. The stoma effluent was transferred in the distal loop within 3 hours to avoid bacterial colonization. An 8-10 Fr feeding tube was advanced 3-5 cm through the distal stoma. The effluent fluid was infused through the feeding tube with a syringe slowly to prevent backflow of the content (**Figure 1C**). Distal loopogram was performed twice: before starting MFR and before stoma closure. The distal colon width measurement at splenic flexure in antero-posterior view was measured in order to compare the width increased within the intervention period (**Figure 2A, 2B**). Weight measurement was also taken before starting MFR and before stoma closure to assess the rate of weight gain.

Figure 1. Methods of collecting proximal effluent either into a poly bag [**1A**] or into a condom [**1B**] and infusing proximal loop effluent into mucous fistula by a syringe [**1C**]

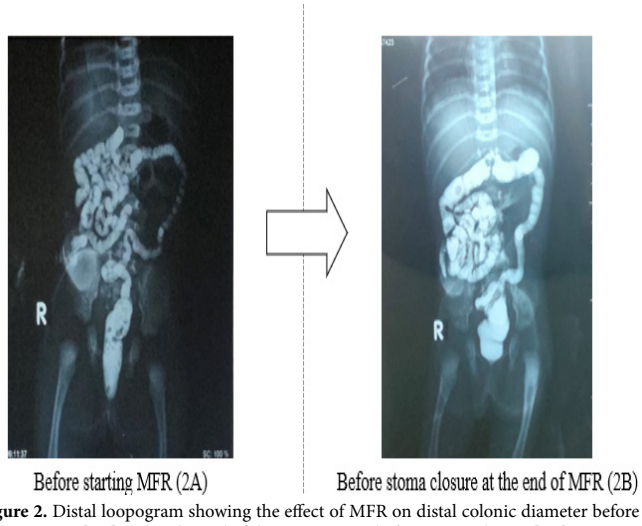

Figure 2. Distal loopogram showing the effect of MFR on distal colonic diameter before starting MFR [**2A**] and at the end of the intervention before stoma closure [**2B**]

MFR: Mucous fistula refeeding

Statiscal Analysis

The statistical analysis was conducted using SPSS (Statistical package for Social Science) version 26 statistical software. Mean and standard deviation for continuous variables and frequency distribution for categorical variables were used to describe the characteristics of the population. Associations of continuous data were assessed using paired t-test. Associations of categorical data were assessed using Chi-square (X^2) test. Value of $p<0.05$ was considered significant.

RESULTS

Ten consecutive patients were included. The underlying diagnosis for enterostomy were meconium ileus (n=3), complicated meconium ileus (n=3) (two with meconium pseudocyst formation and perforation), ileal atresia [3], and intestinal perforation [1] (**Figure 3**).

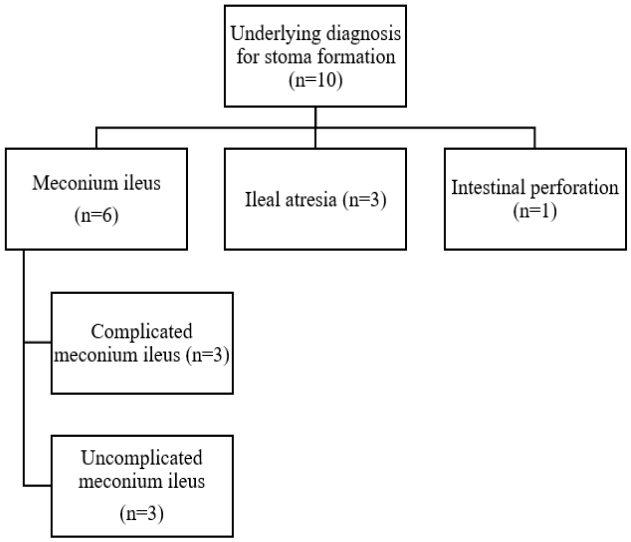

Figure 3. Underlying diagnosis for stoma formation among the participant

Age at start of MFR varied widely, as 4 patients in this series were referred from another hospital, for which refeeding was initiated after 30 days of age. Age at stoma closure also had wide differences, as we delayed the anastomosis where there was satisfactory weight gain and maintenance of hydration and electrolyte balance (**Table 1**).

Mean weight at start of MFR was 2.49 ±0.41 kg and mean weight at end of MFR was 3.38±0.61 kg. Mean rate of weight gain was calculated by dividing the weight gain (W2-W1) by total days of MFR. 18.18±11.6 gm weight was gained per day during refeeding period (**Table 1, Figure 4A**).

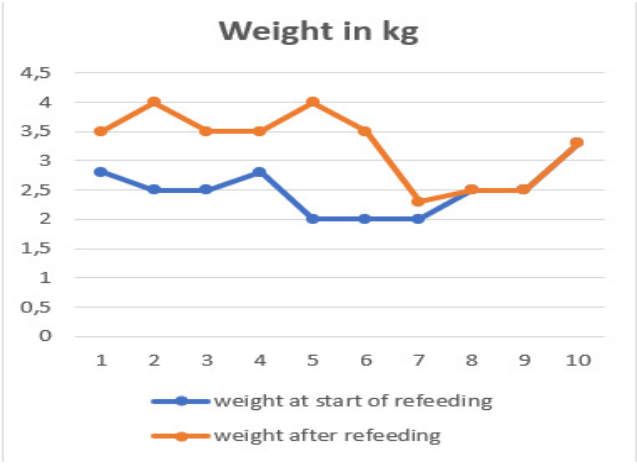

Figure 4A. Increase in weight after MFR

Mean width at splenic flexure of distal loopogram was 6.7±2 mm, which increased to 12±3.4 mm at the end of refeeding. The distal colon width increment rate per day during MFR period was 0.1±.04 mm (**Table 1, Figure 4B**). Both weight and distal gut width increment was statistically significant on paired t test ($p<0.05$) (**Table 2**).

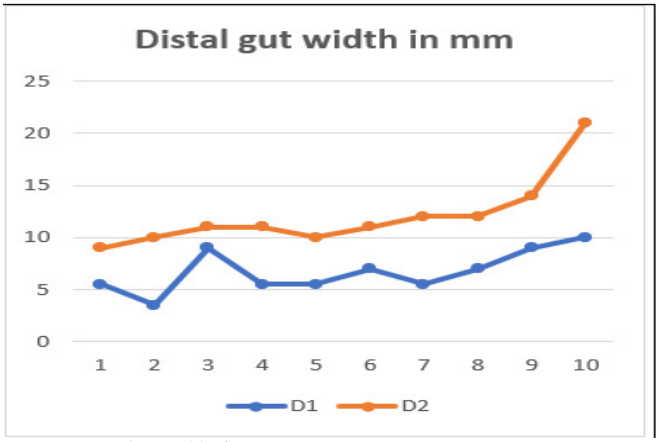

Figure 4B. Distal gut width after MFR

Table 1. Patient's characteristics

Sl no.	Diagnosis	POD[a] of MFR initiation	Total days of MFR	Weight at start of MFR [W1]	Weight after MFR [W2]	D1[b]	D2[c]
1	Meconium ileus	30	30	2.8	3.5	5.5	9
2	Complicated meconium ileus	11	56	2.5	4	3.5	10
3	Jejunoileal atresia	8	36	2.5	3.5	9	11
4	Complicated meconium ileus	11	83	2.8	3.5	5.5	11
5	Complicated meconium ileus	30	60	2	4	5.5	10
6	Meconium ileus	40	48	2	3.5	7	11
7	Meconium ileus	14	41	2	2.3	5.5	12
8	Jejunoileal atresia	21	75	2.5	2.5	7	12
9	Jejunoileal atresia	30	42	2.5	2.5	9	14
10	Intestinal perforation	14	60	3.3	3.3	10	21
Mean±SD		20.9±10.91	53.10±16.993	2.49±0.41	3.38±0.61	6.7±2	12±3.4

[a] Post operative day after stoma formation, [b] Width at splenic flexure at distal loopogram in AP film before MFR [in mm], [c] Width at splenic flexure at distal loopogram in AP film after MFR [in mm], MFR: Mucous fistula refeeding, SD: Standard deviation

Table 2. Statistical analysis by paired t test

	Mean	SD	p
Weight gain [W2-W1]	0.89	0.61	.001
Colon width increment [D2-D1]	5.35	2.4	.000

SD: Standard deviation

After stoma closure one patient suffered a complication: a kinking of bowel just distal to the anastomosis was obstructing the flow, which resulted in leakage, relaparotomy was done and double barrel ileostomy was made, and this was successfully closed after 6 weeks. There was no incidence of bowel perforation or stoma prolapse in our study. However, as our customized proximal effluent collection pouch was not leak proof, an extensive excoriation was seen in all patient before stoma closure, but resolved within a week after enterostomy reversal.

DISCUSSION

In this prospective study we have shown that MFR can be safely performed in the context of middle-low-income settings, and that MFR enhance growth and decrease bowel lumen discrepancy, making stoma closure a safer procedure. In 1983 Levy et al.[11] first introduced the concept of MFR.However, it was first applied on neonates with ileostomy in 1985 by Puppala et al.[14] where he addressed it as ileostomy drip feeding. There, elemental formula was mixed with proximal loop effluent and was transferred to the distal loop by infusion pump.[14] Since the year 2000, MFR has become a routine practice for managing neonates with mucous fistula in high income countries.[11]

The majority of studies regarding MFR have been conducted in high-income countries where there is access to extensive manpower and specialized stoma care.[15] Refeeding is widely practiced and has been shown to shorten the duration of dependence on PN in high-income settings.[16] However, there is a lack studies examining the outcomes of MFR in the absence of PN. This study focused on evaluating the outcomes of MFR in infants with small bowel stoma, particularly in situations where PN is not accessible.

In the context of the present study, the predominant etiology contributing to the formation of small bowel enterostomies was meconium ileus and complicated meconium ileus. A review article highlighted necrotizing enterocolitis (NEC) as the most prevalent cause of enterostomy formation among patients undergoing MFR.[15]

This study demonstrated a significant rate of weight gain after MFR which aligns with the findings of the previous retrospective researches.[2,17,18] Their analysis revealed a significantly higher rate of weight gain in the MFR group compared to both the pre-refeeding and those who did not get refeeding. Other studies have corroborated these results, with reported better weight gain in the MFR group compared to non refeeding group.[19,20]

Wood et al.[16] observed a trend to increased weight gain in the MFR group when compared the result with non refeeding group and found non-significant result. The described insignificant differences in weight gain between the MFR and non-MFR groups may be attributed to the access to PN support which may have contributed to weight gain in control groups.

A retrospective comparative study, showed MFR reduces gut loop discrepancy as well as disuse gut atrophy and postoperative anastomotic leakage.[11] Our study also demonstrated enhancement of gut diameter after refeeding. Likewise, Lee et al.[7] reported statistically significant larger colonic diameter in the refeeding group compared to the control group. However, upon multivariate analysis accounting for post-menstrual age, Lee et al.[7] observed that the colon diameter increment rate was insignificant.

One study has reported hazards related to refeeding process which included perforation during tube insertion.[21] Some authors observed instances of stricture, minor local infections, MF prolapse, and enterocutaneous fistula and stoma bleeding.[20,22] Though we have not faced this sort of complication, maintaining the consistency of MFR at home has been a great challenge.

Limitations

This was one of the limitations of this study, that the caregivers were unsupervised at home while doing refeeding and we had to rely on their words and consider MFR was being done consistently.

CONCLUSION

MFR might enhance growth and reduce nutritional and fluid balance complications and bowel lumen discrepancy making the anastomosis safer during stoma closure. By establishing wide practice of MFR, it is possible to decrease the morbidity and mortality of neonates with small bowel enterostomy.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Ethical Committe Bangladesh Shishu Hospital & Institute (Date: 25.10.2022, Decision No: BSHI/2022/2645).

Informed Consent

Written informed consent was obtained from the parents of all patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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