Management and Outcomes of Meconium ileus, A six-year review

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How to cite this article:
Kuma Dash A, Kumar Kar K, Kumar Mohanty P, Kumar Jena P. Management and Outcomes of Meconium ileus, A six-year review. Iranian Journal of Pediatric Surgery 2023; 9 (2):184 - 198.

DOI: https://doi.org/10.22037/irjps.v9i2.40039

Abstract

Introduction: Meconium ileus is one of the most common causes of intestinal obstruction in the newborn, accounting for 9–33% of neonatal intestinal obstructions[1]. It is characterized by the lack of excretion of meconium caused by impaction of thick, desiccated protein rich pallet like meconium in the distal part of ileum, associated with clinical and specific radiological findings of intestinal obstruction[2]. It is the intestinal obstructive variant of cystic fibrosis[3], Recent studies demonstrate that it can occur frequently without association of cystic fibrosis. The exact pathogenesis of MI in the absence of cystic fibrosis is yet to be known, a spectrum of genetic and pathological abnormalities may play a role[4]. Two forms of meconium ileus can be described, simple and complex meconium

received: 18 November 2022
accepted: 23 June 2023
Published online: 25 October 2023

ileus[4,5]. In 1969, Noblett suggested the use of Gastrografin enema to treat uncomplicated meconium ileus[7].

Many surgical options have been used in the surgical treatment of meconium ileus including resection with Primary anastomosis, Mikulicz ileostomy, Bishop–Koop operation, and Santulli stoma. Resection with primary anastomosis was first described in 1962 [9,15]. An alternative to this approach was small bowel resection with creation of a stoma and eventual closure of the stoma with an end-to-end anastomosis. A distal chimney enterostomy (Bishop-Koop procedure) involves resection of disparately enlarged ileal loop filled with inspissated meconium and anastomosis between the end of the appropriately sized proximal segment to the side of the distal segment of bowel approximately 4 cm from the opening of the distal segment and the distal end is brought out as the ileostomy[8], the reverse of the distal chimney enterostomy is the Santulli and Blanc proximal enterostomy. The Mikulicz double-barreled enterostomy where both proximal and distal loop was exteriorized. Bishop-Koop enterostomy has advantages over other procedure[16,17,18] as 1) it provides access for insertion of a catheter into distal bowel for post operative instillation of solubilizing agents for irrigation, 2) there is also decreased ostomy drainage after 12- 24 hrs of post operative period, so there will be less fluid and electrolyte loss, and 3) Permits an eventual enterostomy closure by bedside ligation of chimney stoma, avoiding another laparotomy for resection and anastomosis of bowel. Here we compare between various methods of treatment of meconium ileus and relative outcome and complications for each method.

Materials and Methods: This is Retrospective study was conducted from March 2016- February 2022 in the Department of Paediatric Surgery, SVPPGIP, S.C.B Medical College and Hospital Cuttack, Odisha. Patients with clinical and radiological suspicion of meconium ileus were

included in the study. They were grouped according to the severity as simple or complicated meconium ileus. Then they were followed up and grouped according to type of intervention carried out. After diagnosis, babies were admitted, resuscitation and stabilization of patients done, Parents were counselled about possible treatment options and prognosis for each patient separately. Patients with simple meconium ileus without any other associated radiological or clinical complication are first treated with conservative management by gastrografin enema under USG guidance. Failed cases and all other simple and complicated cases subjected to different surgical modalities as mention above.

Results: During the study period of six years, total 91 cases (7.5%) were diagnosed to be MI and included in this study. Among 91, 50 were male and 41 were female, 30 cases were Uncomplicated or simple, and 61 cases were complicated MI. Out of 30 simple MI, 18 were managed conservatively and rest 13 cases were managed with operative procedures. Among patient treated with nonoperative management only 7 responded and improved and 9 didn't responded. 84 cases including all cases of complicated MI were treated by exploratory laparotomy. 49 cases were treated by Bishop-Koop ileostomy, 19 Mickulitz double barrel ileostomy and Santuli procedure were done in 11 patients. Primary anastomosis was done only in 5 cases. All cases were followed up for post-operative complications. 13 cases expired during follow up.

Conclusion: MI is a neonatal emergency which need early diagnosis, referral from peripheral hospital and early intervention by Pediatric surgeons. Proper evaluations, careful applications of conservative management, timely and proper surgical interventions may improve survival. Among all surgical procedure Bishop Koop ileostomy

Keywords

- Meconium Ileus
- Enterostomy
- Bishop Koop enterostomy
- Gastrografin enema

procedure is better option to treat MI both in uncomplicated and complicated groups.

Introduction

Meconium ileus is one of the most common causes of intestinal obstruction in the newborn, accounting for 9–33% of neonatal intestinal obstructions[1]. It is characterized by the lack of excretion of meconium caused by impaction of thick, desiccated protein rich pallet like meconium in the distal part of ileum, associated with clinical and specific radiological findings of intestinal obstruction[2]. It is the intestinal obstructive variant of cystic fibrosis[3], Recent studies demonstrate that it can occur frequently without association of cystic fibrosis. The exact pathogenesis of MI in the absence of cystic fibrosis is yet to be known, a spectrum of genetic and pathological abnormalities may play a role[4]. Two forms of meconium ileus can be described, simple and complex meconium ileus [4,5]. Most of cases are simple or uncomplicated meconium ileus but complicated meconium ileus is found in about 40% of patients, e.g., volvulus, atresia, perforation, or meconial pseudocyst[6]. In 1969, Noblett suggested the use of Gastrografin enema to treat uncomplicated meconium ileus[7]. Many surgical options have been used in the surgical treatment of meconium ileus including resection with Primary anastomosis, Mikulicz ileostomy, Bishop–Koop operation, and Santulli stoma. Resection with primary anastomosis was first described in 1962[9,15]. Anastomotic leakage complicated early attempts with this approach. Since then, improved results have beenreported[10,11]. An alternative to this approach was small bowel resection with creation of a stoma and eventual closure of the stoma with an end-to-end anastomosis. A distal chimney enterostomy (Bishop-Koop procedure) involves resection of disparately enlarged ileal loop filled with inspissated meconium and anastomosis between the end of the appropriately sized proximal segment to the side of the distal segment of bowel approximately 4 cm from the opening of the distal segment and the distal end is brought out as the ileostomy[8]. The reverse

of the distal chimney enterostomy is the Santulli and Blanc proximal enterostomy. After resection, the end of the distal limb is anastomosed to the side of the proximal limb and the end of the proximal limb is brought out as the enterostomy. In Mikulicz double-barrelled enterostomy, both proximal and distal loop was exteriorised. Bishop-Koop enterostomy has advantages over other procedures[16,17,18] as: 1) it provides access for insertion of a catheter into distal bowel for post-operative instillation of solubilising agents for irrigation, 2) there is also decreased ostomy drainage after 12- 24hrs of post operative period, so there will be less fluid and electrolyte loss, 3) Permits an eventual enterostomy closure by bedside ligation of chimney stoma, avoiding another laparotomy for resection and anastomosis of bowel. Here we compare between various methods of treatment of meconium ileus and relative outcomes and complications for each method.

Materials and Methods

This retrospective study was conducted from March 2016- February 2022 in the Department of Paediatric Surgery, SVPPGIP, S.C.B Medical College and Hospital Cuttack, Odisha. Patients with clinical and radiological suspicion of meconium ileus were included in the study. They were grouped according to the severity as simple or complicated meconium ileus. Then they were followed up and grouped according to type of intervention carried out. Among the surgically treated patients in post-operative period, they were watched for post-operative outcomes, any complications and each group were compared.

All patients were diagnosed by detailed history and a thorough clinical examination of distended abdomen and typical radiological findings of dilated small bowel loops of disparate size, few air fluid levels and a "ground glass" or "soap bubble" appearance in right lower quadrant (Neuhauser sign)[21], microcolon and reflux of dye into dilated proximal bowel where inspissated pellets of meconium were seen with a contrast enema. Attention was given to find any other associated anomalies. After resuscitation and stabilisation of patients, parents were counselled about possible treatment options and prognosis for each patient separately.

Patients with simple meconium ileus without any other associated radiological or clinical complication are first treated

with conservative management. As we have no fluoroscopy, we used gastrografin enema under ultra sound guidance[12]. Before the procedure adequate hydration and temperature regulation is maintained. Emergency OT was kept ready for any possible adverse effect needing operation like perforation. A red rubber catheter 8-10 French was inserted per anally after lubrication and taped to anus. Gastrografin solution was pushed in slow volume into the catheter and seen under ultrasound for dilatation of colon. It was pushed slowly until it reaches ileocecal junction. If ultrasonic evaluation shows no progress of dilatation, any signs of perforation or if any resistance to push of contrast, then procedure was suspended. After the gastrografin enema we used mucomyst (N-Acetyl Cystine) diluted in NS solution to 3% N-Acetyl cystine solution was given at 5ml/6 hourly through nasogastric tube and 10ml per rectally with strict monitoring of urine output, vitals and temperature monitoring[13,14]. Those patients who did not respond to this treatment and those simple meconium ileus cases presenting late with gross distension and high bilious aspiration were treated by operative management. Among all patient selected to be operated, decision to make the type of surgery was made during operation. Maximum patients were treated by Bishop-Koop ileostomy. Others were treated by Santuli or Mickulitz double barrel ileostomy. Among Simple meconium ileus, 5 cases were treated with primary anastomosis but no case of complicated meconium ileus were treated with primary anastomosis. Patients were kept under NICU care and monitored for drain output, functioning of the stoma and presence of any complication.

Result

During the study period total number of OPD cases seen in department of paediatric surgery were 78,254 and total indoor admission were 7635 cases. Among the admitted cases 1213 were neonatal intestinal obstruction, out of which 91 cases (7.5%) were diagnosed to have meconium ileus and included in this study. The cases were then grouped on different criteria and were compared.

Among 91 cases of meconium ileus 50 were male (55%), And 41 were female (45%). So slight male predominance is seen in this study. Among all cases of meconium ileus 30 cases were Uncomplicated or simple meconium ileus, and 61 cases were complicated meconium

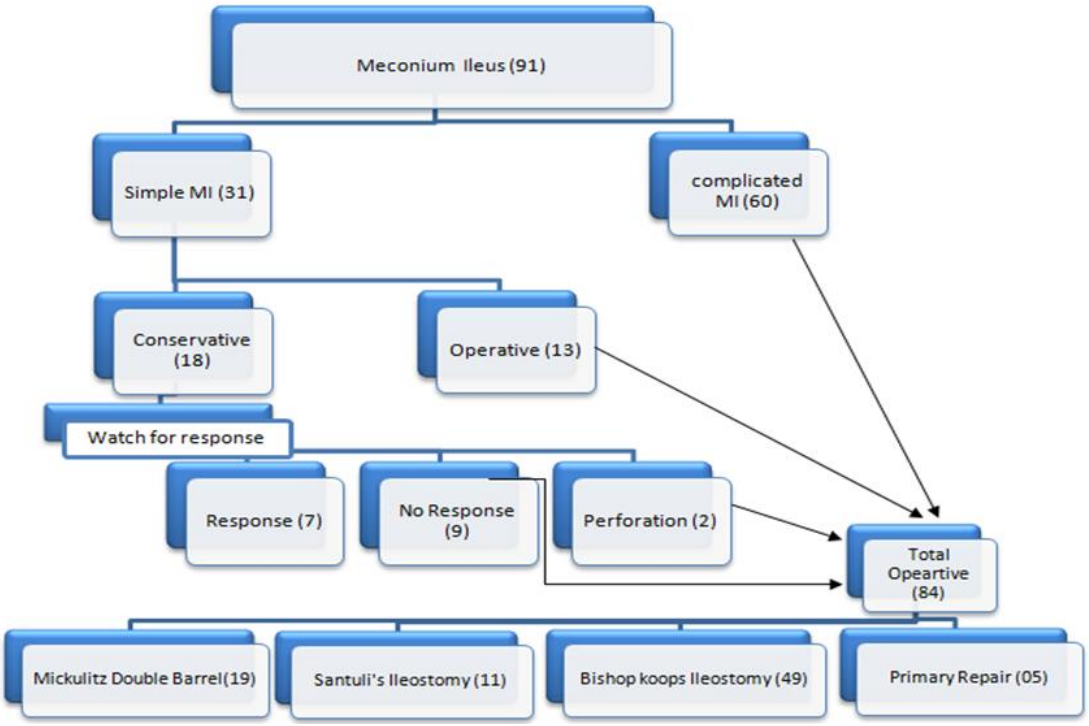
ileus. Clear higher percentage of complicated meconium ileus were seen. Although cases of meconium ileus presented in different time periods after birth, it was found that complicated meconium ileus presented late with mean of 4.2 days in comparison to simple meconium ileus presenting on 2.6 days. Isolated meconium ileus was found in maximum number of cases 80 (88%), associated anomalies found only in 11% cases (06). **(Table 1)**

Table 1: comparison of meconium ileus with intestinal obstruction and distribution according to sex, presentation and association

Neonatal Intestinal Obstruction (1213)					
Meconium Ileus (91), 7.5%					
Sex		**Presentation**		**Association**	
Male	**Female**	**Simple**	**Complicated**	**Isolated**	**Associated anomaly**
50	41	30	61	80	11
55%	45%	33%	67%	88%	12%

All complex meconium ileus cases were managed by operative means. Among uncomplicated or simple meconium ileus cases 18 were managed nonoperatively by Gastrografin enema under ultrasonography and the remaining 13 cases were managed with operative procedures. Among the patients treated with nonoperative management only 7 responded and improved and 9 didn't respond and had to go for laparotomy, and 2 patients showed signs of perforation and taken for emergency surgery; So, altogether 84 cases were treated by exploratory laparotomy.

49 cases were treated by Bishop-Koop ileostomy, 19 Mickulicz double barrel ileostomy and Santuli procedure were done in 11 patients. Primary anastomosis was done only in 05 cases.



Distributions of cases according to management

Among complicated meconium ileus mostly presented with perforation, other cases had gangrene of the loaded ileum, associated ileal atresia, small bowel volvulus and meconium pseudocyst formation. Few cases have more than one presentation. **(Table 2)**

Table 2: findings in complicated meconium ileus

Findings	Number	Percentage
Perforation and peritonitis	16	26.7%
Gangrene of the loaded ileum	13	21.6%
Meconium pseudo cyst	13	21.6%
Small gut volvulus	11	18.3%
Intestinal atresia	5	8.3%

Among all the post-op complications in simple meconium ileus, high output fistula is seen mostly in Santuli and Mickulicz procedure. Anastomotic leak is significantly higher in Primary anastomosis. Sepsis is more or less seen in every primary procedure. Surgical site wound infection is seen in primary anastomosis patient only. Skin excoriation is more common in Mikulicz double barrel and Santuli procedure. Re-exploration needed in some primary anastomosis patients and they were converted to Mickulicz double barrel in reoperation. Mortality is highest among patients with primary anastomosis patients. Among all cases of complicated meconium ileus operated, high output fistula is seen in Mickulicz method followed by Santuli's method. None of the cases were operated in complicated cases with primary anastomosis, wound infection, reoperation and mortality was higher in Santuli method. Skin excoriation is higher in Mickulicz method. Sepsis and mortality were high in case of complicated meconium ileus cases. Among patients with meconium ileus highest mean hospital stay is seen in case of Santuli procedure and least in case of conservative treatment. **(Table 3)**

Table 3: comparison of post op meconium ileus cases (84).

	simple meconium ileus cases (24)					complicated meconium ileus cases(60)				
Complications	***Mickuliz double barrel (05)***	***Bishop koop (10)***	***Santuli (04)***	***Primary anastomosis (05)***	***Total (24)***	***Bishop koop (39)***	***Mickuliz double barrel (14)***	***Santuli (07)***	***Primary anastomosis (00)***	***Total (60)***
High output fistula	04(80%)	02(20%)	02(50%)	00	08(33%)	08(20.5%)	12(85.7%)	03(42.8%)	NA	23 (38.3%)
Anastomotic leak	00	00	01(25%)	03(60%)	04(16%)	01(2.5%)	00	03(42.8%)	NA	04(6.6%)
Sepsis	02(40%)	01(10%)	02(50%)	03(60%)	08(32%)	15(38.4%)	07(50%)	05(71.4%)	NA	27(45%)
Wound infection	00	01(10%)	00	02(40%)	03(12%)	07(17.9%)	05(35.7%)	03(42.8%)	NA	15(25%)
Skin excoriation	03(60%)	01(10%)	02(50%)	00	07(28%)	04(10.2%)	12(85.7%)	04(57.1%)	NA	20(33.3%)
Reoperation	00	00(40%)	02(50%)	03(60%)	05(20%)	04(10.2%)	07(50%)	05(71.4%)	NA	16(26.6%)
Mortality	01	00	00	03(60%)	04(16.6%)	05(12%)	05(35.7%)	03(42.8%)	NA	13(21.6%)

Discussion

In our study total number of meconium ileus accounted for about 7.5% of total intestinal obstructions, which is less than that showed in the literature of 8-33%. In our study male to female ratio is 1.2:1, which is slightly more male predominance. Study by HaithemHAli [10] showed male to female ratio of 0.9:1. Other studies also showed slightly higher female predominance. Simple meconium ileus accounts for 33% of cases which is compared to other studies, 47.1% in study by Rescorla et.al[22], 58% in study by Murshed R et.al[25], but this is comparable with numbers in the study by HaithemHAliAlmoamin[10].Higher percentage of complex cases maybe due to ineffective prenatal diagnosis of meconium ileus and the consequent delayed diagnosis and referral to us. Among simple meconium ileus cases managed conservatively, we can see only 7 patients responded to conservative treatment by USG guided Gastrografin enema, which is 39% and is in accordance with other studies by Karimi et al[23](39%) and Murshed R et al[25] (40%) and HaithemHAliAlmoamin[10](45.5%).

Initially 13 patients who presented late or huge distension of abdomen were not chosen for conservative management and kept for operative management. Mean age of presentation is 3.6 days, but it ranges from 16 hrs to 8 days. It is seen that mean age of presentation in simple meconium ileus is as early as 2.6 days, whereas in complicated cases it is 4.2 days. It can be interfered that the late presentation of the disease results in perforation, peritonitis, and gangrene like complications in these group of patients. In patient with meconium ileus, associated anomalies seen in only 12% of the cases. Associated anomalies include jejunal atresia, ileal atresia & rectal atresia. In our study the complicated meconium ileus was grouped according to the associated complications. Here the maximum number of associated complications is intestinal perforation, gangrene of the loaded ileum and meconium pseudocyst being 27%, 21.6% & 21.6%. Next common associated anomalies found are small gut volvulus, and intestinal atresia. In the study done by KaziMd Noor-ulFerdous et al[11], small gut volvulus was highest in occurrence. He also has mentioned multiple complications in single patient. In case of simple or uncomplicated meconium ileus (24 cases), {meconium ileus with huge abdominal

distention (13 cases) or failed non-operative treatment (non-responders-9 cases and 2 cases developed perforation during the procedure)}, and complicated meconium ileus (60 cases) surgical intervention were done. The most common procedures done here were Bishop-Koop procedure in 44 cases (52.3%), Mikulicz procedure in 24 cases (28.5%), Santuli in 11 cases (13%) and resection with primary anastomosis in 5 cases (6 %); and it was not done in any complicated meconium ileus patients but with simple meconium ileus patient. The small number of cases treated by primary anastomosis may give contrasting result for the rate of complications and should be interpreted cautiously. High output fistula occurring in higher numbers in both the groups postoperatively which is 33% and 38% and is comparable with other studies by Haithem H Ali Almoamin[10] was 42% but it contradicts the study done by A. Karimietal[23]. Anastomotic leak is found higher in primary anastomosis procedure (60%), which is in accordance with other studies. Sepsis was seen in higher rates - 32% and 45% - in both groups, respectively, as compared to 26.7% of A. Karimi[23] study and 34.6% of Almoamin[1] study. High output diarrhea and skin excoriation occur mostly in neonates treated with Mikulicz procedures. Anastomotic leaks with peritonitis occur mostly in patients treated with resection and primary anastomosis. In primary anastomosis, significant complications were anastomotic leak, sepsis, and reoperation done in 60% of cases. The overall mortality was high (16.6 and 21.6%) in comparison with other studies where the survival was between 85-100%[13-15]. The best survival was encountered in patients treated with Bishop-Koop procedures in both simple and complex meconium ileus, followed by Mickulicz procedure, and the worst result was with primary anastomosis. High mortality can be explained by higher incidence of sepsis in late presenting meconium ileus cases. Since primary anastomosis cases have higher rate of complications and deaths than resection with stoma creation, we prefer stoma creation rather than primary anastomosis in both simple and complex meconium ileus. Resection with stoma creation is the safer procedure, preventing peritonitis due to anastomotic leakage but the need later on for closure of stoma being a relative disadvantage, which can be avoidable in Bishop-Koop procedure. Escobar et al[24]

suggests that resection with primary anastomosis should only be used in case of atresia, resection with enterostomy being preferable in complex meconium ileus patients. Mean hospital stay was less in conservative management and Bishop-Koop Ileostomy procedure and more in Santuli followed by Mikulicz ileostomy procedure. It is in accordance with the study done by K M N Ferdous et al[11].

Conclusion

Meconium ileus consists 7.5% of total intestinal obstruction seen in the newborn period. MI is a neonatal emergency which need early diagnosis, referral from peripheral hospital and early intervention by pediatric surgeons. Proper evaluations, careful applications of conservative management, timely and proper surgical interventions may improve survival. Among all surgical procedures, Bishop-Koop ileostomy procedure is a better option to treat MI both in uncomplicated and complicated patients.

Ethical Consideration

This study received ethical code from the ethical committee of SCB medical college and hospital, Cuttack, India with code number 472-11.02.2021.

Acknowledgment

Not applicable

Funding/Support

Not applicable

Conflict of interests

There is no conflict of interest

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