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COMPARISON BETWEEN OUTCOME OF CHIMNEY ENTEROSTOMY AND MIKULICZ ENTEROSTOMY FORMATION IN PATIENTS OF COMPLICATED MECONIUM ILEUS

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Abstract

Objective: *To compare the outcome of Bishop- Koop chimney enterostomy and Mikulicz enterostomy formation among patients with complicated meconium ileus.*

Study Design: *Randomized Controlled trial.*

Selling: *Pediatric Surgery Department, Nishtar Hospital, Multan.*

Duration: *06 months after approval of synopsis from: December 2024 to May 2025.*

Methodology: *Following IERB approval, 102 neonates/infants were recruited. After informed consent, they were randomized into two groups: Group A (Bishop-Koop) and Group B (Mikulicz Enterostomy), 51 cases in each group. Postoperative outcomes including anastomotic leakage, high-output diarrhea, and sepsis were recorded for comparison.*

Results: *Group-A had significantly more males (p = 0.028), while gestational age and birth weight were similar across groups. Anastomotic leakage (37.3% vs. 15.7%; p = 0.014) and sepsis (51.0% vs. 25.5%; p = 0.008) were significantly higher in Group-A. No cases of high-output stoma were observed in either group. Stratified analysis showed worse outcomes in Group-A among males and patients with gestational age >36 weeks or birth weight >3 kg. Hospital stay was slightly longer in Group-B, but the difference was not statistically significant.*

Conclusion: *Mikulicz Enterostomy proved safer and more effective than Chimney Enterostomy in reducing postoperative complications in complicated meconium ileus. These findings support its use in similar clinical settings, with further studies needed for long-term validation.*

INTRODUCTION

Meconium ileus is characterized by obstruction of the neonatal intestine due to dry, sticky, and protein-laden meconium in the distal ileum.[1-2] With an incidence of 1:2500 newborns, meconium ileus contributes to 9–33% of neonatal intestinal obstructions. It has two types: Simple, where thick meconium obstructs the terminal ileum causing proximal dilation and bowel wall changes, and Complicated, which includes perforation, necrosis, or intra-abdominal calcifications.[3] Non-surgical management, particularly gastrografin enemas, is preferred for simple meconium ileus; operative intervention is pursued only when conservative methods do not work.[4] Nearly half of the

complicated meconium ileus cases—manifesting as volvulus, peritonitis, or meconium pseudocyst—require surgery. Treatment involves enterotomy with irrigation or enterostomy, with or without resection, employing methods like Bishop-Koop, Santulli, Mikulicz, or Chimney procedures.[5-7]

The Chimney and Mikulicz ileostomy techniques are standard procedures for treating complicated meconium ileus, but their clinical outcomes and complication rates can vary. Selecting the most effective surgical method for meconium ileus remains uncertain and challenging. A 10-year retrospective study by Haithem H. Ali et al.[8] examined 57 cases treated at Basrah Children Specialty Hospital's NICU, comparing the Mikulicz and Bishop-Koop procedures with resection and primary anastomosis in both simple and complicated cases. In this cohort, 33.3% of neonates had simple meconium ileus. Volvulus was the leading complication (47.4%), and non-operative management succeeded in 45.5% of cases. Most were treated with the Mikulicz method (61.5%), followed by Bishop-Koop (30.8%) and primary anastomosis (7.7%). The Mikulicz procedure demonstrated the best survival, while primary anastomosis had the poorest outcomes. High-output fistula was most often seen in Mikulicz cases. Primary anastomosis led to the highest rates of anastomotic leak (66.7% and 100%), whereas Bishop-Koop showed moderate leakage (25%, 41.7%) and Mikulicz had none. Complications in the Mikulicz group were mainly high-output fistula (50%) and skin excoriation (53.1%). Bishop-Koop was complicated by sepsis (75%), reoperation (50%), and adhesions (25%). In contrast, primary anastomosis frequently resulted in leaks, sepsis (50%), and reoperation (50%). Total mortality was 45.6%, with better outcomes in non-operative cases (100% survival) compared to surgical cases (50%). Resection with stoma creation, particularly via the Mikulicz method, is superior and safer, while Bishop-Koop may be preferable when managing anticipated high-output stomas.

In a 2018 study, Ferdous et al.[9] evaluated the effectiveness of Mikulicz and Bishop-Koop procedures in complicated meconium ileus. Of 224 neonates (mean age 3.23 days), 8 were excluded due to missing data, and 24 were preterm. Uncomplicated MI made up 57% of cases, with the remainder being complicated. Among 112 uncomplicated cases, 11 had Mikulicz, 37 had Bishop-Koop, and the others underwent T-tube ileostomy. Of the 104 complicated cases, Mikulicz was performed in 75 and Bishop-Koop in 42.

Predominant complications in Mikulicz procedures were high output fistula (67.6%), sepsis (34.84%), and skin excoriation (58.33%), while in Bishop-Koop procedure, complications were sepsis (59.25%), anastomotic leak, and reoperation (25.75%). In T-tube ileostomy, complications were intra-peritoneal leak with reoperation and sepsis (9.52%). Twenty-five (11.6%) stoma prolapses were found in Mikulicz ileostomy.[10] The overall mortality of meconium ileus was 36.6%, in simple MI 23 out of 112 (21%), and in complicated MI 56 out of 104 (54%). Considering the study result, it is concluded that complications occur more frequently in Mikulicz procedure and it is significantly associated with mortality, Bishop-Koop ileostomy can be considered but anastomotis leak is still an important complication of this procedure. In uncomplicated cases T tube ileostomy found as the best option.

Ideal surgical procedure to treat Complex Meconium ileus is still a matter of debate and challenging for surgeons as well. To the best of our knowledge, there is not enough literature about the outcomes of two methods, such as Chimney and Mikulicz enterostomy but there is a relative lack of literature in examining the treatment outcomes and guideline. Therefore, this study is designed to compare the outcomes of chimney versus Mikulicz enterostomy formation in patients of complicated meconium ileus. The results of this study will be help to create awareness in these clinicals regarding ideal surgical procedure with less complication while dealing with Complex Meconium ileus in neonates and also provides better treatment options to the patients to avoid further major complications such as peritonitis due to anastomosis leakage, high output diarrhea septicemia urinary tract infection & reoperation.

METHODOLOGY:

This randomized controlled trial was conducted in the Pediatric Surgery Department at Nishtar Hospital, Multan, over six months following approval from the Institutional Ethical Review Board (IERB) of Nishtar Medical University, Multan. A

total of 102 neonates diagnosed with complicated meconium ileus, meeting the inclusion criteria, were enrolled using non-probability consecutive sampling. The inclusion criteria comprised neonates with complex meconium ileus of both genders, while neonates with multiple congenital anomalies or those whose parents refused participation were excluded from the study. Parental informed consent was obtained after explaining the study objectives and procedures. Baseline characteristics, including gender, gestational age, birth weight, and residential status, were documented for all enrolled cases. The neonates were then randomly allocated into two groups using the lottery method. Group A, comprising 51 neonates, underwent the Bishop-Koop Procedure, while Group B, also consisting of 51 neonates, was managed with the Mikulicz Enterostomy procedure. Both procedures were performed by a consultant pediatric surgeon to ensure uniformity in surgical technique and postoperative management. Following surgery, patients were closely monitored for the occurrence of anastomotic leakage, high output stoma, and sepsis. Anastomotic leakage was clinically assessed based on abdominal distension and the presence of intraperitoneal fluid on ultrasound. High output stoma was defined as a 24-hour stoma output exceeding 20 mL/kg/day, leading to dehydration. Sepsis was diagnosed based on clinical signs, including temperature deregulation, tachycardia, tachypnea, hypotension, and laboratory markers such as elevated C-reactive protein (CRP), leukocytosis, or leukopenia. Sepsis confirmation was also supported by blood culture and sensitivity testing. The total hospital stay from the day of surgery to discharge was recorded. All collected data were systematically recorded on a structured proforma and analyzed using SPSS version 23.0. Continuous variables such as gestational age, birth weight, and hospital stay were presented as mean and standard deviation. Categorical variables, including anastomotic leakage, high output stoma, sepsis, and mortality rate, were expressed as frequencies and percentages. The Chi-square test was applied to compare categorical complications between the two groups, while an independent sample t-test was used to analyze differences in hospital stay, with a significance threshold of $p < 0.05$. Data were further stratified based on gender, gestational age, and birth weight to ensure a comprehensive comparison. Post-stratification, the Chi-square test was used to analyze categorical outcomes, and an independent sample t-test was conducted to compare hospital stay between the two groups.

RESULTS:

Table 1: Demographic Information

The study included a total of 102 patients with complicated meconium ileus, divided equally into Group-A (Chimney Enterostomy) and Group-B (Mikulicz Enterostomy), each comprising 51 patients. The gender distribution revealed a statistically significant difference between the groups ($p = 0.028$), with Group-A having a higher proportion of males (54.9%) compared to Group-B (33.3%). Conversely, females were more common in Group-B (66.7%) than Group-A (45.1%). Regarding gestational age, most patients in both groups were delivered after 36 weeks: 82.4% in Group-A and 88.2% in Group-B; this difference was not statistically significant ($p = 0.402$). Similarly, birth weight distribution was comparable between the groups, with 62.7% of Group-A and 60.8% of Group-B weighing more than 3 kg ($p = 0.839$). The mean birth weight was 3.13 ± 0.52 kg in Group-A and 3.10 ± 0.42 kg in Group-B ($p = 0.711$). The average hospital stay was slightly higher in Group-B (20.88 ± 5.21 days) compared to Group-A (20.23 ± 3.96 days), but this difference was not statistically significant ($p = 0.480$).

Table 2: Comparison of Outcomes Between the Two Procedures

This table compares the clinical outcomes between chimney and Mikulicz enterostomy techniques. Anastomotic leak was observed significantly more frequently in Group-A (37.3%) compared to Group-B (15.7%), with a statistically significant difference ($p = 0.014$). Sepsis was also notably higher in Group-A, affecting 51.0% of patients compared to 25.5% in Group-B ($p = 0.008$). Regarding high output stoma, all patients in both groups had no such complication, indicating a 100% rate of "No" for this outcome in both groups. These findings suggest that the Mikulicz procedure was associated with lower rates of complications in comparison to the chimney enterostomy technique.

Table 3: Outcome Comparison by Effect Modifiers

When outcomes were stratified according to gender, gestational age, and birth weight, further insights emerged. Among males, anastomotic leak was significantly higher in Group-A (84.6%) compared to Group-B (15.4%) (p = 0.048), while the difference among females was not significant (p = 0.14). Similar trends were noted across gestational ages and birth weights, with a significant difference in anastomotic leak observed in patients with gestational age >36 weeks (p = 0.009) and birth weight >3 kg (p = 0.038). For high output stoma, no cases were recorded in any group, across all subgroups, thus no statistical comparison was possible. Regarding sepsis, a significantly higher proportion of male patients in Group-A (84.2%) experienced sepsis compared to those in Group-B (15.8%) (p = 0.009). This pattern was not statistically significant in females (p = 0.275). Among those born after 36 weeks, sepsis was again more prevalent in Group-A (63.6%) compared to Group-B (36.4%) with statistical significance (p = 0.025). Similarly, a higher proportion of sepsis cases was observed in patients with birth weights of 2–3 kg in Group-A (68.8%) compared to Group-B (31.2%) (p = 0.037), but the difference was not statistically significant for those with birth weights >3 kg (p = 0.082).

Table 4: Comparison of Hospital Stay by Effect Modifiers

Hospital stay durations were analyzed by gender, gestational age, and birth weight. Among male patients, the mean hospital stay was slightly longer in Group-A (20.58 ± 4.43 days) than in Group-B (19.98 ± 5.92 days), though not statistically significant (p = 0.701). In contrast, female patients in Group-B had a higher mean stay (21.32 ± 4.85 days) compared to Group-A (19.80 ± 3.34 days), also without statistical significance (p = 0.194). For gestational age, patients between 32–36 weeks showed nearly identical hospital stays between Group-A (21.02 ± 4.11 days) and Group-B (20.97 ± 5.78 days) (p = 0.983). Similarly, in those delivered at >36 weeks, the difference was modest and not significant (p = 0.420). Lastly, in the birth weight subgroup, lighter infants (2–3 kg) in Group-B had a longer mean hospital stay (21.38 ± 5.63 days) than those in Group-A (19.13 ± 3.31 days), but this difference did not reach statistical significance (p = 0.139). Among infants with birth weight >3 kg, hospital stay durations were very similar between the groups (p = 0.780).

Table 1

DEMOGRAPHIC INFORMATION OF PATIENTS OF COMPLICATED MECONIUM ILEUS(n=102)

Variable		Group-A (n=51)	Group-B (n=51)	Total	P-value
Gender	Male	28 (54.9%)	17 (33.3%)	45 (44.1%)	0.028[a]
	Female	23 (45.1%)	34 (66.7%)	57 (55.9%)	
Gestational Age	32-36 weeks	9 (17.6%)	6 (11.8%)	15 (14.7%)	0.402[a]
	>36 weeks	42 (82.4%)	45 (88.2%)	87(85.3%)	
Birth Weight	2-3 kgs	19 (37.3%)	20 (39.2%)	39 (38.2%)	0.839[a]
	>3 kgs	32 (62.7%)	31(60.8%)	63 (61.8%)	
Mean Birth weight(kgs)		3.13±0.52	3.10±0.42	-	0.711[b]
Mean Hospital stay		20.23±3.96	20.88±5.21	-	0.480[b]

[a] chi square test

[b] independent t test

Table 2

COMPARISON BETWEEN OUTCOME OF CHIMNEY ENTEROSTOMY AND MIKULICZ ENTEROSTOMY FORMATION IN PATIENTS OF COMPLICATED MECONIUM ILEUS(n=102)

Variable		Group-A	Group-B	Total	P-value[a]
Anastomotic Leak	Yes	19 (37.3%)	8 (15.7%)	27 (26.5%)	0.014
	No	32 (62.7%)	43(84.3%)	75 (73.5%)	

High Output Stoma	Yes	~	~	~	~
	No	51(100%)	51(100%)	102(100%)	
Sepsis	Yes	26 (51.0%)	13 (25.5%)	39(38.2%)	0.008
	No	25 (49.0%)	38(74.5%)	63(61.8%)	

[a] chi square test

Table 3
COMPARISON BETWEEN OUTCOME OF CHIMNEY ENTEROSTOMY AND MIKULICZ ENTEROSTOMY FORMATION IN PATIENTS OF COMPLICATED MECONIUM ILEUS ACCORDING TO VARIOUS EFFECT MODIFIERS(n=102)

Variable		Group	Group-A	Group-B	P-value
Anastomotic Leak	Male	Yes	11 (84.6%)	2 (15.4%)	0.048
		No	17 (53.1%)	15 (46.9%)	
	Female	Yes	8 (57.1%)	6 (42.9%)	0.14
		No	15 (34.9%)	28 (65.1%)	
	32–36 weeks	Yes	2 (66.7%)	1 (33.3%)	0.792
		No	7 (58.3%)	5 (41.7%)	
	>36 weeks	Yes	17 (70.8%)	7 (29.2%)	0.009
		No	25 (39.7%)	38 (60.3%)	
	2–3 kg	Yes	5 (71.4%)	2 (28.6%)	0.184
		No	14 (43.8%)	18 (56.2%)	
	>3 kg	Yes	14 (70.0%)	6 (30.0%)	0.038
		No	18 (41.9%)	25 (58.1%)	
High Output Stoma	Male	Yes	0 (0%)	0 (0%)	N/A
		No	28 (62.2%)	17 (37.8%)	
	Female	Yes	0 (0%)	0 (0%)	~
		No	23 (40.4%)	34 (59.6%)	
	32–36 weeks	Yes	0 (0%)	0 (0%)	~
		No	9 (60.0%)	6 (40.0%)	
	>36 weeks	Yes	0 (0%)	0 (0%)	~
		No	42 (48.3%)	45 (51.7%)	
	2–3 kg	Yes	0 (0%)	0 (0%)	~
		No	19 (48.7%)	20 (51.3%)	
	>3 kg	Yes	0 (0%)	0 (0%)	~
		No	32 (50.8%)	31 (49.2%)	
Sepsis	Male	Yes	16 (84.2%)	3 (15.8%)	0.009
		No	12 (46.2%)	14 (53.8%)	
	Female	Yes	10 (50.0%)	10 (50.0%)	0.275
		No	13 (35.1%)	24 (64.9%)	
	32–36 weeks	Yes	5 (83.3%)	1 (16.7%)	0.132
		No	4 (44.4%)	5 (55.6%)	
	>36 weeks	Yes	21 (63.6%)	12 (36.4%)	0.025
		No	21 (38.9%)	33 (61.1%)	
	2–3 kg	Yes	11 (68.8%)	5 (31.2%)	0.037
		No	8 (34.8%)	15 (65.2%)	
	>3 kg	Yes	15 (65.2%)	8 (34.8%)	0.082

		No	17 (42.5%)	23 (57.5%)	

Table 4
COMPARISON BETWEEN OUTCOME (HOSPITAL STAY) OF CHIMNEY ENTEROSTOMY AND MIKULICZ ENTEROSTOMY FORMATION IN PATIENTS OF COMPLICATED MECONIUM ILEUS ACCORDING TO VARIOUS EFFECT MODIFIERS(n=102)

Effect Modifiers		Group-A (Mean ± SD)	Group-B (Mean ± SD)	P-value
Gender	Male	20.58 ± 4.43	19.98 ± 5.92	0.701
	Female	19.80 ± 3.34	21.32 ± 4.85	0.194
Gestational Age:	32–36 weeks	21.02 ± 4.11	20.97 ± 5.78	0.983
	>36 weeks	20.06 ± 3.96	20.86 ± 5.20	0.42
Birth Weight:	2–3 kg	19.13 ± 3.31	21.38 ± 5.63	0.139
	>3 kg	20.88 ± 4.21	20.55 ± 4.99	0.78

DISCUSSION:

This study, conducted in Pakistan, aimed to compare the clinical outcomes of two surgical approaches—Chimney Enterostomy and Mikulicz Enterostomy—in patients with complicated meconium ileus. The results demonstrate that the Mikulicz technique was associated with significantly better postoperative outcomes in terms of lower rates of anastomotic leak and sepsis, although there was no difference in high output stoma, which did not occur in any patient.

Our findings are consistent with international studies conducted in different settings. For example, Karimi et al. (2011)[11] from Iran reported that outcomes of complicated meconium ileus vary based on the surgical approach, particularly when meconium consistency and bowel viability are not adequately addressed. Their analysis emphasized that procedures involving enterostomy were associated with higher rates of complications like leak and infection. In this context, the lower complication rates observed in the Mikulicz group in our study support its utility as a safer alternative.

Similarly, a systematic review by Donos et al (2024),[12] conducted in Europe, provided a comprehensive evaluation of surgical outcomes in meconium ileus cases and highlighted complication rates between 18% and 38%, underscoring the lack of standardized protocols. Our findings contribute to this literature by presenting evidence from a South Asian population, favoring Mikulicz Enterostomy in managing complicated cases, with a notably reduced incidence of sepsis (25.5%) and anastomotic leak (15.7%) compared to Chimney Enterostomy. The influence of demographic and clinical modifiers was also evident in our analysis. Stratification by gender revealed significantly better outcomes for males undergoing the Mikulicz procedure, particularly in terms of reduced sepsis and anastomotic leak. This gender-based difference may reflect variable immune responses or perioperative care, although the precise mechanisms remain unclear.

Stratification by gestational age further supported the superiority of the Mikulicz technique, particularly in infants delivered after 36 weeks. These infants exhibited significantly fewer complications, possibly due to better bowel maturity. Similar trends were noted in infants weighing more than 3 kg, where enhanced physiologic reserves and healing capacity may contribute to improved outcomes. Hospital stay did not significantly differ between the groups overall, though subgroup analysis showed that female patients in the Mikulicz group had a slightly longer hospital stay, despite experiencing fewer complications. This suggests that factors such as feeding tolerance and other comorbidities may play a role in determining length of hospitalization.

In contrast to the study by Hasan et al[13] conducted in a different geographical context and focusing on uncomplicated cases, our study addresses more complex clinical presentations. Their comparison of T-tube ileostomy with Bishop-Koop procedures showed that outcomes were influenced more by surgical technique than patient characteristics. Our results echo this conclusion, particularly regarding the impact of surgical choice on postoperative complications. Overall, the findings of this Pakistani

study align well with those of international research, adding valuable regional data to the global body of literature on meconium ileus management.

Conclusion

This study concludes that Mikulicz Enterostomy is a safer and more effective surgical option than Chimney Enterostomy in managing complicated meconium ileus, particularly in terms of reducing postoperative complications such as anastomotic leak and sepsis. While demographic and clinical factors such as gender, gestational age, and birth weight do influence outcomes, the choice of surgical technique remains a critical determinant. The results provide strong support for adopting the Mikulicz approach in similar healthcare settings in Pakistan and can inform surgical decision-making in resource-limited environments. Future multicenter studies are recommended to validate these findings and evaluate long-term outcomes.

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