Annals of Neonatology

OPEN ACCESS
ISSN: 2636-3596

Original Article

The Effect of Early Enteral Feeding on Neonatal Outcome after Gastrointestinal Tract Surgery in Assiut University Children Hospital. A Prospective Clinical trial

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DOI: 10.21608/ANJ.2024.300234.1092
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Abstract

Objective: This prospective clinical trial aimed to evaluate the effect of early vs late enteral feeding after GIT surgery on neonatal outcome after surgery, weight gain, length of hospital stay (LOHS), time to reach full enteral feeding (FEF), time to first stool passage, sepsis, surgical site infection (SSI) and electrolyte disturbances. **Methods:** The study conducted at Assiut University Children Hospital during the period from 1st of July 2021 to the end of June 2022 and included 84 neonates who were undergoing GIT surgery. The study included 2 groups: group A who started enteral feeding (EF) within 2 days postoperative and group B who started EF after 2 days postoperative according to clinician discretion based on the clinical progress. **Results:** Tolerance was higher among neonates in group A (P=0.030). The LOHS at the post-operative time was shorter among neonates in group A compared to group II (P<0.001). The development of sepsis was significantly higher among neonates in group B compared to group A (P<0.001). During the follow up period of the studied participants, 18 cases died with total mortality rate of (18/84, 21.4%); among them 2/18 (11.1%) from neonates in group A versus 16/18 (88.9%) from neonates in group B with a highly significant difference between both studied groups (P<0.001). **Conclusion:** Early enteral feeding (EEF) in neonates within 2 days following gastrointestinal tract surgeries is beneficial in reducing the length of hospital stay (LOHS), sepsis and mortality. Also it improved weight gain at time of discharge and decreased risk of post-operative complications as anastomotic site leak.

Key words: Neonates, early enteral feeding, neonatal outcome, GIT surgery.

Introduction

There are many causes for Gastrointestinal tract (GIT) surgery and the goal after surgery is to establish patients on enteral feeding (EF) and wean them off of TPN. The fear of aspiration, nausea, vomiting and anastomotic complications makes the routine prescription of "Nothing per oral/nil by mouth" [1]. The duration of postoperative fasting is variable and can range from 0 to 5 days depending on the operation. This period of fasting may prolong length of hospital stays (LOHS), increase use of TPN, social effects and significant costs to the health system. [2] Neonates may lose their body resources after surgery due to inadequate nutrient intake and undergoing long periods of fasting after surgery. Starvation leads to disuse atrophy of villi, decrease disaccharide activity, decreased intestinal mucosa mass, and loss of DNA of enterocyte. This malfunctioning enterocyte leads to increase the permeability of intestinal mucosa to antigen and macromolecules. [1]

Aim of the study: to evaluate the effect of early vs late enteral feeding after abdominal surgery on neonatal outcome after surgery, weight gain, length of hospital stay, time to reach full enteral feeding, time to pass first stool, surgical site infections, sepsis and electrolyte disturbances.

Patients and Methods

Study design and place:

This prospective clinical trial was carried out in Neonatal intensive care unit at Assiut University Children's Hospital during the period from 1st of July 2021 to the end of June 2022. All admitted neonates (full term and preterm) who underwent GIT surgery were included except neonates with any contraindication for oral intake such as patients on mechanical ventilation and neonates with other co-morbidities like sepsis, severe respiratory distress, intra cranial hemorrhage, birth asphyxia, congenital heart diseases, multiple

congenital anomalies, and metabolic diseases. The study included 84 neonates. The patients were divided into 2 groups, according to the time of start of EF postoperatively according to surgical decisions based on clinical progress. Group A: started EF within 2 days postoperatively, and Group B: started EF after 2 days postoperatively. The two groups are matched as regards: weight, gestational age, sex, age at the time of operation and type of operation.

Data collection All neonates in the study were subjected to: History of gestational age, sex, birth weight, the age and weight at the time of admission, age at the time of surgery, type of the GIT anomalies. Through examination of the cases was done regarding vital signs and tolerance assessment. complete blood count, Kidney Function Tests, liver function tests, Prothrombin time and concentration, INR, C-reactive protein, and electrolyte were done for the studied cases. Patients started EN by trophic feeding (early or late) and gradually increased according to the tolerance of the patients with gradual weaning from Total Parenteral Nutrition till reach FEF. Assessment of weight gain, LOHS, time to reach FEF, time of first stool passage, surgical site infection (SSI), post-operative complications, and sepsis were followed up till time of discharge.

Ethical consideration

Reviewing the proposal was carried out before starting and approved by the ethical committee of the Assiut Faculty of Medicine in accordance with the Declaration of Helsinki. Written and informed consent was obtained from the patient's caregivers to participate in the study after an explanation of its purpose and being advised of their right to withdraw from the study at any time. Patients were coded for data entry so their names could not be identified.

Statistical analysis:

All statistical calculations were done using SPSS (statistical package for the social science; SPSS Inc., Chicago, IL, USA) version 22. Data were statistically

described in terms of mean ± standard deviation (±SD), median, and range for non-normally distributed data, frequencies (number of cases), and relative frequencies (percentages) when appropriate. Comparison of quantitative variables between the study groups was done using the Whitney U test as the data were not normally distributed. The McNemar test was used for comparing paired binomial data overtime. For comparing categorical data, a Chi-square ($\chi 2$) test was performed. The exact test was used instead when the expected frequency was less than 5. A P-value is always 2 2-tailed set significant at 0.05 level.

Results

There was no significant difference between the studied groups regarding weight, gestational age, and sex and regarding the types of gastro-intestinal tract anomalies. The baseline data of the studied cases are summarized in Table 1 and Table 2. The time of first stool passage was significantly shorter among neonates in Group A (P<0.001). Feeding tolerance was significantly higher among neonates in Group A (P=0.030). While time to reach full enteral feeding (FEF) was significantly prolonged among neonates in Group B (median was 14 days vs 7 days, P<0.001), Table 3.

The developed complications namely (SSI, and surgical complications as leakage, blood from colostomy, stenosed anastomotic site, and dilated jejunum) were comparable between both groups with no significant difference between them. While the development of sepsis was significantly higher among neonates in Group B compared to Group A (23 cases (54.8%) vs. 5 cases (11.4%), P<0.001) in both groups respectively, Table 4.

Regarding postoperative outcome, Weight at time of discharge was significantly higher among neonates in Group A compared to Group B (2.70 ± 0.46 VS 2.34 ± 0.40 P<0.001), the LOHS was significantly shorter among neonates in Group A compared to Group B

(median was 11 days vs. 23 days, P<0.001) in both groups respectively, 18 cases died with a total mortality rate of (18/84, 21.4%). Among them; 2/18 (11.1%) in Group A versus 16/18 (88.9%) in Group B, with a highly significant difference between the studied groups (P<0.001), as shown in table 5.

Table 1: Baseline data of the studied neonates

Variable name	Total (n=84)	Group A (n=42)	Group B (n=42)	P value
Gestational age (weeks)				0.4
• Mean ± SD	36.89 ± 1.55	37.32 ± 1.12	36.45 ± 1.81	
Birth weight (kg)				0.28
• Mean ± SD	2.62 ± 0.49	2.77 ± 0.49	2.46 ± 0.45	
Gender				0.291
• Male	52 (60.5)	29 (65.9)	23 (54.8)	
• Female	34 (39.5)	15 (34.1)	19 (45.2)	
Age at time of admission (days)				0.831
• Mean ± SD	4.76 ± 5.35	4.84 ± 5.89	4.67 ± 4.80	
Age at time of surgery (days)				0.862
• Mean ± SD	7.88 ± 6.98	7.55 ± 6.22	8.24 ± 7.76	

Group A: start enteral feeding within 2 days postoperative
Group B: start enteral feeding after 2 days postoperative according to clinician discretion based on clinical progress

Table 2: Types of gastro-intestinal tract anomalies among the studied neonates

Item	Total (n=84)		Group A (n=42)		Group B (n=42)		P value
Anomalies							0.096
• TEF	22	(26)	10	(23.8)	12	(28.6)	
• Intestinal atresia	17	(20.2)	8	(19)	9	(21.4)	
• Imperforate anus	11	(13.1)	8	(19)	3	(7.1)	
• Malrotation	12	(14.3)	6	(14.3.)	6	(14.3)	
• Exomphalous	6	(7.0)	5	(11.9)	1	(2.4)	
• Perforated viscus	5	(5.9)	1	(2.4)	4	(9.5)	
• Meconium ileus	3	(3.6)	0	(0.0)	3	(7.1)	
• Midgut volvulous	2	(2.4)	1	(2.4)	1	(2.4)	
• Gastroschiasis	2	(2.4)	0	(0.0)	2	(4.8)	
• Cloacal extrophy	2	(2.4)	2	(4.7)	0	(0.0)	
• Inguinal hernia	2	(2.4)	1	(2.4)	1	(2.4)	

Variables are presented as frequency (%). Significance defined by $p < 0.05$.
Group A: start enteral feeding within 2 days postoperative Group B: start enteral feeding after 2 days postoperative according to clinician discretion based on clinical progress

Table 3: post-operative feeding Pattern among the studied neonates

Variables	Group A (n=42)	Group B (n=42)	P value
Time to start feeding post-operatively (days)			**<0.001**
• Median (range)	2 (0 – 46)	9 (6 – 23)	
Time to reach FEF post-operatively (days)			**<0.001**
• Mean ± SD	7.93 ± 6.02	15.30 ± 6.01	
Time of first stool passage (days)			**<0.001**
• Mean ± SD	2.68 ± 1.83	5.88 ± 4.28	
Feeding tolerance, n (%)			**0.030**
• No	12 (28.5)	21(50.0)	
• Yes	30 (71.5)	21(50.0)	

Variables are presented as mean ± standard deviation, median (range). Variables are presented as frequency (%). Significance defined by $p < 0.05$.Group A: start enteral feeding within 2 days postoperative
Group B: start enteral feeding after 2 days postoperative according to clinician discretion based on clinical progress

Table 4: Complications developed among studied neonates

Variable name	Group A (n=42)		Group B (n=42)		P value
Surgical complications					
No	36	(85.7)	31	(73.8)	0.152
Yes	6	(14.3)	11	(26.2)	
▪ Wound leakage	1	(50.0)	3	(50.0)	
▪ Bleeding from colostomy	1	(50.0)	1	(16.7)	
▪ Stenosed anastomotic site	0	(0.0)	1	(16.7)	
▪ Dilated jejunium	0	(0.0)	1	(16.7)	
▪ SSI	4	(9.1)	5	(11.9)	0.736
▪ Sepsis					
• No	39	(88.6)	19	(45.2)	**<0.001**
• Yes	5	(11.4)	23	(54.8)	

Variables are presented as frequency (%). Significance defined by p < 0.05.Group A: start enteral feeding within 2 days postoperative Group B: start enteral feeding after 2 days postoperative according to clinician discretion based on clinical progress

Table 5: Outcome of the studied neonates

Variable name	Group A (n=42)	Group B (n=42)	P value
Weight at time of discharge (kg)			**<0.001**
• Mean ± SD	2.70 ± 0.46	2.34 ± 0.40	
Length of post-operative hospital stay (days)			**<0.001**
• Mean ± SD	13.55 ± 8.02	24.10 ± 8.81	
Outcome (Survival)			**<0.001**
• Improved	40 (95.2)	26 (61.9)	
• Died	2 (4.8)	16(38.1)	

Variables are presented as frequency (%). Significance defined by p < 0.05.
Group A: start enteral feeding within 2 days postoperative
Group B: start enteral feeding after 2 days postoperative according to clinician discretion based on clinical progress

Discussion

Our study showed no significant difference between both groups regarding gestational age, weight, sex and age at time of surgery. (Table 1) In agreement with Shakeel et al. [3], Shores et al. [4] and Passaro et al. [5]. In contrast to Thompson et al. [6] who showed that majority of infants were

female (58%) and 62% of infants born preterm.

Types of surgical anomalies in our study were Tracheoesophageal fistula in 22 cases (26%), intestinal atresia in 17 cases (20.2%), imperforate anus in 11 cases (13.1%), malrotation in 12 cases (14.3%), exomphalos in 6 cases (7.0%), perforated viscus in 5 cases (5.9%), and meconium ileus in three cases (3.6%). Midgut volvulus, gastroschisis, cloacal extrophy, and inguinal hernia were documented in two cases (2.4%, for each). With no significant difference between the studied groups (P=0.096), (Table 2). In agreement with Shakeel et al.[3] and Shores et al.[4] .

Our study showed that the time to start EF and time to reach FEF were significantly shorter in group A compared to group B. Significantly higher tolerance to EF was found in group A compared to group B. (Table 3) In concordance with the current study Khademi et al. [7] showed that the EF group have significantly shorter duration of feeding with nasogastric tube (NGT) and consequently shorter duration to reach FEF. But in contrast to the current study, they reported no difference in tolerance between the studied groups, this contrast may be related to differences in sample size and the surgery type. In agreement with the current study a systematic review and meta-analysis of 4 RCT studies, comprising 97 cases with early enteral feeding (EEF) and 89 cases with delayed enteral feeding (DEF) showed that the EEF group had faster tolerance of FEF ($p < 0.00001$) [8]. Moreover, in line with the current study Prasad et al. [1] studied the feasibility and effect of EEN in 79 neonates following abdominal surgeries. The study showed that EEF group has significantly higher tolerance than DEF group.

The current study revealed that the EEF (group A) resulted in significant reduction in the duration to first stool passage compared to DEF (group B) ($p < 0.001$). (Table 3) In agreement with the

current study Prasad et al.[1] showed that first stool appeared earlier in EEF group than DEF group.

Regarding complications, our study showed that the EEF group has a significantly lower incidence of sepsis compared to DEF group (11.4% vs. 54.8% $p < 0.001$). However, there was no significant difference between the studied groups as regarding SSI or surgical complications. (Table 4) Behera et al. [9] in their systematic review and meta-analysis showed that that the incidence of SSI, septic complications as well as overall complications were significantly lower in the EEN group. In contrast Shang et al. [10] showed that there was no significant difference between EEF and DEF groups as regard sepsis among 575 pediatric patients undergoing surgical intervention with GI anastomosis. The disagreement may be due to difference in sample size. Consistent with the current study Peng et al. [11] and, Tian et al.[8] showed that there was no significant difference between the studied groups as regard surgical complications.

Regarding outcome, the current study showed that the EEF group have significantly higher weight at time of discharge compared to DEF (2.7± 0.46 vs 2.34±0.40; $p<0.001$) (Table 5) Our result are consistent with Ghorbani et al. [12] in their RCT they concluded that EEF in neonates with Esophageal atresia repair surgery can improve the weight index in neonates with Ea. Also, Peng et al. [11] showed that EEF and DEF showed comparable effect on weight for age, as both resulted in significant increase in weight for age.

The current study revealed that the LOHS was significantly shorter in group A compared to group B (13.55 ± 8.02 vs. 24.10 ± 8.81 days; $p<0.001$). (Table 5) In concordance with the current study Khademi et al.[7], Prasad et al.[1], Peng et al., 2021, Behera et al.[9] and Tian et al.[8] showed that the EEF group have significantly shorter LOHS compared to DEF group .

The current study showed that EEF resulted in significant reduction in mortality rate compared to DEF group (4.2% vs. 38% respectively; p<0.001). (Table 5)In contrast to the current study Peng et al.[11] showed that there was no significant difference between the studied groups as regard 30-day mortality rate, only one case died in DEF group.

Conclusions

Early enteral feeding (EEF) in neonates within 2 days following GIT surgeries is beneficial in reducing the LOHS, mortality, and sepsis. Also improve weight gain at time of discharge and decrease risk of post-operative complications as anastomotic site leak.

Data Availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Acknowledgements:

We would like to thank all medical staff at NICU of Minia university hospital for their support.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported only by the Faculty of Medicine, Assiut University.

Authors' contributions

AA performed the study design and revised the whole work. SM revised the data collection, recording of the results and the interpretation of results, and helped to draft the manuscript. SA data collection and recording analyzed, and interpreted the data and performed the statistical analysis, and wrote the manuscript. All authors read and approved the final manuscript as submitted.

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Date received: 2nd May 2024, accepted 6th July 2024

Abbreviations

DEF Delayed enteral feeding

EEF Early enteral feeding

EF Enteral feeding

FEF Full enteral feeding

GIT Gastrointestinal tract

LOHS Length of hospital stays

SSI Surgical site infection

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Citation: Sandy Nashat Rezk; Azza Ahmed El Tayeb; Safwat Mohamed Abdel-Aziz. "The Effect of Early Enteral Feeding on Neonatal Outcome after Gastrointestinal Tract Surgery in Assiut University Children Hospital. A Prospective Clinical trial". *Annals of Neonatology*, 2024; 6(2): 47-59. doi: 10.21608/anj.2024.300234.1092