Pediatr Surg Int (2017) 33:783–786
DOI 10.1007/s00383-017-4084-5

ORIGINAL ARTICLE

Outcome of stoma closure in babies with necrotising enterocolitis: early vs late closure

Debasish Bijoykrishna Banerjee[1] · Hasanthi Vithana[1] · Shilpa Sharma[1] · Thomas Tat Ming Tsang[2]

Accepted: 27 March 2017 / Published online: 22 April 2017

Abstract Newborns undergoing surgery for necrotizing enterocolitis (NEC) often require a stoma. Currently, there is no consensus regarding the best time for stoma closure (SC). Our aim was to determine the outcomes of early versus late closure.

Methods Retrospective analysis of patients who underwent SC following stoma formation for NEC between Jan 2009 and July 2015 was done. Early (EC) versus late closure (LC) was defined as less than 10 weeks versus at or after 10 weeks of stoma formation.

Results Of 36 patients, M:F was 23:13. Indications for laparotomy were pneumoperitoneum (30) and gangrene (6). Postoperatively, 9/15 (60.0%) of EC group required ventilator support versus none in LC group ($p < 0.05$). It took longer to establish full feeds following EC (12 days) versus LC (8 days). Median duration of postoperative hospital stay following EC was 31 days (18–35) versus 7 days (4–54) following LC. Three patients were re-operated for intestinal obstruction (two following EC, one following LC). Three patients developed incisional hernia after EC versus none after LC ($p < 0.05$). One patient died after EC due to staphylococcus septicaemia.

Conclusion Early closure before 10 weeks of formation for NEC patients is associated with significant morbidity, increased ventilator requirements and chances of developing incisional hernia.

✉ Thomas Tat Ming Tsang
debasishbanerjee24@yahoo.co.uk

[1] Great Ormond Street Hospital for Children NHS Trust, Greater London, London, UK

[2] Norfolk and Norwich University Hospitals NHS Foundation Trust, Colney Lane, Norwich, UK

Keywords Necrotizing enterocolitis · Stoma closure · Early stoma closure · Late stoma closure · Stoma reversal

Introduction

Necrotizing enterocolitis (NEC) is one of the common surgical emergencies in the newborns. With the aims of removing the gangrenous bowel and preserving as much bowel length as possible, a stoma is often fashioned as a temporising measure allowing the NEC affected bowel to recover. At present, there is no consensus regarding the ideal time for the stoma closure. While some groups advocate early stoma closure (EC), others recommend waiting till the infants are older than 8–10 weeks [1–3]. Here, we present our experience to determine if there is difference in the outcomes of infants with regards to the timing of closure of the stoma.

Methods

We retrospectively reviewed the medical records of all patients who had stoma formation for NEC and underwent stoma closure (SC) between Jan 2009 and July 2015. Data collected included gestational age, birth weight, indications for laparotomy, age and weight at the time of SC, ventilator support after SC, time to initiate and establish feeds and complications after SC. The severity of NEC was assessed clinically, laboratory results (white blood cell count, C-reactive protein, platelet count) and radiological findings (Modified Bell's staging criteria for NEC). The timing of stoma closure was adjudged when the optimum balance between the feeds and the enteral losses could be established. As a protocol, prior to the closure, distal stomal dye

study (loopogram) was done to ensure patency and assess the continuity of the bowel. Following stoma closure, the need for ventilator support and subsequently weaning from it was based on standard neonatal intensive care unit (NICU) protocol. Using synchronised, pressure-control volume-guaranteed ventilation, weaning and extubation was considered as the rate and mean airway pressure were deemed satisfactory. Postoperatively, feeds were started when the nasogastric tube aspirates were clear and/or bowels sounds were present and/or the baby had opened bowels. The initial regime was to introduce 2-h trophic feeds (10 ml/kg/day) for the first 24 h and if tolerated well to increase at the rate of 20 ml/kg/day.

For analytical purposes, patients were grouped into the early stoma closure (EC) who had stoma reversal done before 10 weeks of formation and the late stoma closure (LC) at or after 10 weeks of formation. The comparison of the two groups was done by the Student's *t* test. The study was done as an audit based on standard hospital trust guidelines for clinical audits and hence ethically approved.

Results

Thirty-six patients with NEC were included in this study. Babies who had stoma formation for other intestinal pathologies were excluded. The indications for initial laparotomy were pneumoperitoneum (30/36) and gangrene (6/36). The number of patients in EC: LC was 15:21. The demographic data of the patients is outlined in Table 1 (Tables 2, 3).

Discussion

Necrotizing enterocolitis remains a challenging neonatal surgical emergency. Among the many surgical options available, resection of the gangrenous intestine and exteriorization of the viable ends, thereby creating a stoma are the approaches in most cases. The appropriate timing for stoma reversal in neonates with NEC has been debated [4]. Some authors advocate early stoma reversal to prevent chronic salt and water losses [1]. It is also claimed to promote earlier use of the entire available gut and thereby reducing parenteral nutrition burden. However, earlier attempts of closure may be met with a peritoneal cavity that is obliterated by vascular adhesions and resolving inflammation and many consider it is safer to delay stoma closure by at least 8 weeks [2]. Musemeche et al. compared the complication rate after stomas were closed less than 3 months after surgery, 3–5 months after surgery, and more than 5 months after surgery; and found no differences [5]. A similar conclusion of no difference in outcomes whether the stoma was closed early or late was found by Veenstra et al. [6]. In our reported series, the need for postoperative ventilation was found in 60.0% of the patients in the EC group and none in the LC group. This may be attributed to the respiratory problems inherent to the younger age of the EC group. Some of the less mature babies in this group, post-conception age of less than 37 weeks, would certainly risk having further barotraumas to the lungs. If this is complicated with abdominal distension due to postoperative ileus, the ventilation is further compromised. Because of this problem, one patient from the EC group required the stoma to be reformed. In our experience, neonates who underwent EC required a longer duration to attain full enteral nutrition and thus needed longer parenteral nutritional support. Similar findings have been reported by others [2]. As premature infants are at increased risk of developing parenteral nutrition (PN) associated liver disease secondary to immature liver development and incomplete enzyme activity, our babies received SMOF (Soyabean/Medium Chain Triglyceride/Olive oil/Fish oil emulsion) in their PN under the supervision of a dedicated gastroenterology team [7]. Second, the duration to establish full feeds was longer in the EC group (median 12 vs 8 days).We attribute this to be multifactorial, including factors such as premature age and

Table 1 Demographic data of 36 patients with early (EC) and late (LC) stoma closure

	EC ($n = 15$)	LC ($n = 21$)
Male:female	7:8	11:10
Gestational age (week), median (range)	26 + 6 (23 + 5–40 + 5)	27 + 3 (24–33 + 2)
Birth weight (kg), median (range)	0.89 (0.60–3.30)	1.05 (0.62–2.01)
Gestational age at stoma reversal (week), median (range)	37 + 4 (31 + 5–44 + 3)	53 + 1 (42–108 + 6)
Weight at stoma reversal (kg), median (range)	2.20 (1.20–3.60)	4.30 (2.70–7.00)

There was no difference between the two groups with regards to the median age of gestation and the median birth weight. The median weight at the time of SC in the EC group was just half of that in the late closure group (2.2 vs 4.3 kg). The most common site of the stoma was the ileum (89%)

Table 2 Recovery following a stoma reversal

	EC ($n = 15$)	LC ($n = 21$)
No. of patients requiring postoperative ventilation	9 (60.0%)	0
Days to start enteral feeds after stoma reversal, median (range)	5 (3–8)	4 (1–14)
Days to establish full enteral feeds after stoma reversal, median (range)	12 (7–30)	8 (4–50)
Postoperative days in hospital, median (range)	31(18–35)	7 (4–54)

Postoperatively, there were notable differences in the need of ventilation (60.0 vs 0%), duration to establish full feeds (12 vs 8 days) and days to discharge (31 vs 7) between the EC group and LC group. The complications after the stoma reversal are shown in Table 3

Table 3 Complications after stoma closure

	EC ($n = 15$)	LC ($n = 21$)	p value
Wound infection	1 (6.7%)*	1 (4.7%)	0.8124
Anastomotic leak	1 (6.7%)	0	0.2422
Anastomotic stricture	1 (6.7%)	0	0.2422
Intestinal obstruction	2 (13.3%)	1 (4.7%)	0.3733
Incisional hernia	3 (20.0%)	0	0.0327
Ventilated	9 (60.0%)	0	<0.0001

Using Student's t test, p values of <0.05 were considered significant. Our data showed incisional hernia and the need for ventilation was more in the EC group. One (*) patient in the EC group died due to staphylococcal septicaemia and there was also recurrence of NEC

ongoing recovery phase of the initial episode of NEC. Immature immunological defence and inadequate nutritional reserve also makes the younger babies more prone to poor wound healing and thereby increases susceptibility to infection. These factors predisposed them to develop incisional hernia, seen in 20.0% in the EC group and none in the late group. So far it is not clear whether body weight should be a criterion for deciding the timing of stoma closure. The recent experience of Talbot et al. showed that stoma reversal at lower weight (<2 kg) did not associate with higher risk of perioperative complications (11). However, others found weight of less than 2.5 kg to be a significant factor for anastomotic dehiscence (8.9). In the current series, two patients (13.3%) in the EC group with median weight of 2.2 kg developed anastomotic complication compared to none in the LC group. NEC in newborns accounts for high morbidity and mortality especially when associated with co-morbid sepsis [11]. With the provision of good neonatal care to overcome the initial life-threatening crisis, it is vital to judiciously decide the timing of stoma closure in an attempt to prevent further morbidities. Our study being retrospective, there are some limitations inherently. Though we have records of the birth weight and gestational age of the groups we compared, we might have missed subtle clinical differences that would have influenced the decision to close the stoma. Second, we admit that there has been assumption bias as it was assumed that both the groups were clinically similar. Third, we are aware that the total number of patients is relatively small.

Conclusion

Although some infants may merit early enterostomy reversal, this study shows that it carries higher morbidity with requirement of ventilatory support postoperatively, longer time to establish feeds, longer hospital stay and higher chances of re-operation. We consider a multi-disciplinary approach in managing high stomal output, nutrition requirement and premature newborn development, necessary to optimize timing of stoma closure achieving the best outcome and minimal complication.

Acknowledgements We sincerely acknowledge the contribution of the following Paediatric Surgery consultants of our department whose patients' data was also used for this paper: Mr. A. B. Mathur, Mr. A. Minocha, Mr. M. S. Kulkarni and Mr. R. J. England.

References

1. Rothstein FC, Halpin TC Jr, Kliegman RJ, Izant RJ Jr (1982) Importance of early ileostomy closure to prevent chronic salt and water losses after necrotizing enterocolitis. Pediatrics 70:249–253
2. Al-Hudhaif J, Phillips S, Gholum S, Puligandla PP, Flageole H (2009) The timing of enterostomy reversal after necrotizing enterocolitis. J Pediatr Surg 44(5):924–927
3. Gertler JP, Seashore JH, Touloukian RJ (1987) Early ileostomy closure in necrotizing enterocolitis. J Pediatr Surg 22(2):140–143
4. Struijs MC, Sloots CE, Hop WC, Tibboel D, Wijnen RM (2012) The timing of ostomy closure in infants with necrotizing enterocolitis: a systematic review. Pediatr Surg Int 28(7):667–672
5. Musemeche CA, Kosloske AM, Ricketts RR (1987) Enterostomy in necrotizing enterocolitis: an analysis of techniques and timing of closure. J Pediatr Surg 22(6):479–483
6. Veenstra M, Nagappala K, Danielson L, Klien M (2015) Timing of ostomy reversal in neonates with necrotizing enterocolitis. Eur J Pediatr Surg 25(3):231–235
7. Attard MI, Patel N, Simpson J (2012) Change from intralipid to SMOF lipid is associated with improved liver function in infants with PN associated liver disease. Arch Dis Child 97:54–55
8. Lee J, Kang MJ, Kim HS, Shin SH, Kim HY, Kim EK (2014) Enterostomy closure timing for minimising postoperative complications in premature infants. Pediatr Neonatol 55:363–368

9. Weber TR, Tracy TF Jr, Silen ML, Powell MA (1995) Enterostomy and its closure in newborns. Arch Surg 130:534–537
10. Talbot LJ, Sinyard RD, Rialon KL, Englum BR, Tracy ET, Rice HE, Adibe OO (2017) Influence of weight at enterostomy reversal on surgical outcomes in infants after emergent neonatal stoma creation. J Pediatr Surg 52:35–39
11. Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, Merek L, Bhutta Z, Barros AJD, Mathers C, Cousens SN (2014) Every Newborn: progress, priorities, and potential beyond survival. Lancet 384:189–205
12. Kliegman RM, Walsh MC (1987) Neonatal necrotizing enterocolitis: pathogenesis, classification and spectrum of disease. Curr Probl Pediatr 17(4):243–288