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The impact of body weight on stapled anastomosis in pediatric patients

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ABSTRACT

Purpose: The purpose of this study is to clarify the impact of body weight on outcomes of stapled anastomosis in pediatric patients.
Methods: A total of 253 pediatric patients who underwent intestinal anastomosis were classified according to body weight (<3.5 kg: light group, ≥3.5 kg: heavy group), and clinical outcomes of stapled and hand-sewn anastomoses were compared.
Results: The light and heavy groups included 77 (stapled: n = 13, hand-sewn: n = 64) and 176 (stapled: n = 58, hand-sewn: n = 118) patients, respectively. In both groups, stapled anastomosis was associated with reduced time to initial oral feeding (light group: 4 vs. 7 days, $p = 0.006$; heavy group: 3 vs. 5 days, $p < 0.001$) and full feeding (light group: 12 vs. 16 days, $p = 0.026$; heavy group: 7 vs. 9 days, $p = 0.001$), whereas its complication rate was not significantly different from that of hand-sewn anastomosis (light group: 30.8 vs. 12.5%, $p = 0.112$; heavy group: 3.4 vs. 2.5%, $p = 0.665$). In patients who underwent stapled anastomosis, the complication rate was significantly higher in the light group (30.8 vs. 3.4%, $p = 0.009$), with two cases of volvulus related to anastomotic dilatation.
Conclusions: Stapled anastomosis is an effective procedure facilitating prompt oral feeding. However, the risk of complications, including volvulus related to anastomotic dilatation, should be considered among patients weighing <3.5 kg.
Level of evidence: III.

Intestinal anastomosis in pediatric patients has traditionally been performed using the hand-sewn end-to-end approach. After the introduction of stapled functional end-to-end anastomosis (FEEA) in neonates and infants by Powell in 1995 [1], the procedure is gradually being accepted among pediatric surgeons.

To date, there have been a few studies about the safety and efficacy of stapled anastomosis in neonates and infants [1–6], which reported the efficacy of stapled over hand-sewn anastomosis, including shorter operative time [2,5,6], time to full feeding and hospitalization [6], and no difference in adverse outcomes between both types of anastomoses [2,5,6]. These studies compared the clinical outcomes in neonates and infants; however, we assumed that body size can affect the outcomes because the size of the intestinal lumen or vulnerability of the tissue changes considerably because of the significant growth of pediatric patients. Therefore, in this study, we compared the outcomes of stapled FEEA and hand-sewn anastomosis by stratifying patients according to their body weights at the time of surgery.

1. Material and methods

1.1. Patients

This study included pediatric patients <15 years of age who underwent an intestinal anastomosis at Saitama Children's Medical Center in Japan between 2000 and 2016. These patients were stratified into two groups (light group: body weight < 3.5 kg and heavy group: body weight ≥ 3.5 kg), and the clinical outcomes of stapled FEEA and hand-sewn end-to-end anastomosis were compared within each group in terms of operative time, estimated blood loss, time to initial oral feeding, time to full feeding, and complications.

1.2. Surgical methods

Hand-sewn anastomosis was performed in an end-to-end manner using absorbable suture material. FEEA was performed using an

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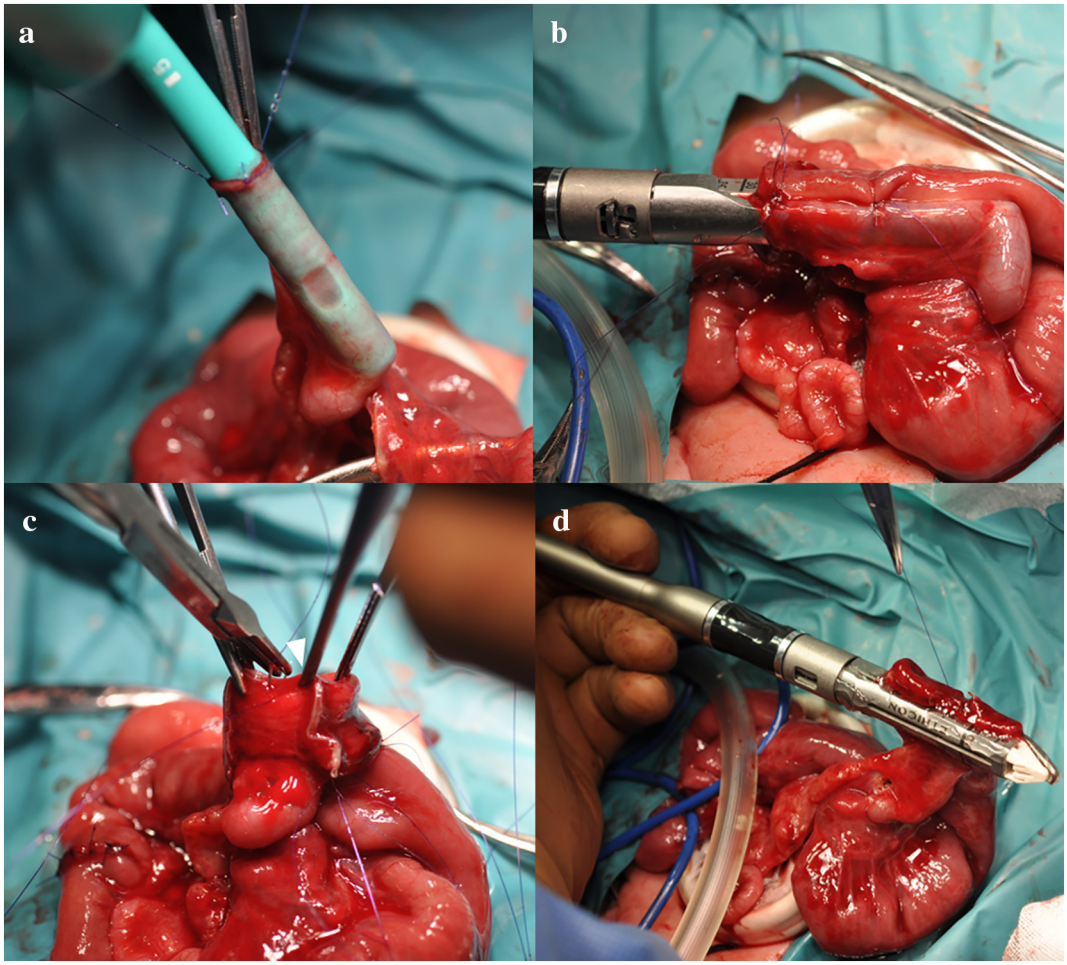

Fig. 1. Stapled functional end-to-end anastomosis procedure. a. A 22-Fr. soft catheter is inserted into the intestinal tract. b. Proximal and distal intestinal limbs are sutured together, and the stapler is inserted into the intestinal limbs. A side-to-side anastomosis is made in both limbs at the antimesenteric border. c. The staple lines are oversewn for reinforcement of the crotch (arrowhead) of the side-to-side anastomosis. d. The stapler is again fired across the joined intestinal limbs to close the enterotomies. The suture line of the side-to-side anastomosis should not overlap. The staple lines are oversewn at points of bleeding for hemostasis and for reinforcement of double-stapled areas.

Endocutter ETS 35, ETS Flex 45 stapler, and the Echelon Flex Powered ENDOPATH Stapler with 2.5- or 3.5-mm staples (Johnson & Johnson K.K., Tokyo, Japan) as shown in Fig. 1. Following the first side-to-side anastomosis at the antimesenteric border in both intestinal limbs, the staple lines were oversewn to reinforce the crotch. Thereafter, the stapler was again fired across the joined intestinal limbs to close the enterotomies. The suture line of the side-to-side anastomosis should not overlap, and the staple lines were oversewn to reinforce the double-stapled areas. Stapled anastomosis was introduced to our center in March 2009, with its application based on surgeons' preference. Of note, stapled anastomosis was not considered for children in whom a 22-Fr soft catheter could not be inserted into the intestinal lumen or when stapling would significantly compromise the total intestinal length or the ileocecal valve, and thus, these cases were excluded from our study.

1.3. Statistical analysis

Continuous variables were presented as median (interquartile range). Statistical analyses were performed using Fisher's exact test for categorical variables and the Mann–Whitney U-test for continuous variables. A p-value <0.05 was considered statistically significant.

1.4. Ethics

This study protocol was approved by the Ethical Committee at Saitama Children's Medical Center. Guardians of all patients gave informed consent.

2. Results

2.1. Patient characteristics

Over the 17-year period, 253 pediatric patients underwent either stapled (n = 71) or hand-sewn anastomosis (n = 182), the demographic data of whom are summarized in Table 1. Patients who underwent stapled anastomosis were significantly older (295 [149–993] vs. 204 [62–511] days, $p = 0.022$) and heavier (7.5 [5.5–12.4] vs. 6.5 [2.9–8.5] kg, $p = 0.007$) at the time of surgery.

The characteristics of the light and heavy groups are summarized in Tables 2 and 3, respectively. The light group included 77 patients, 13 of whom had undergone stapled anastomosis, and the rest had undergone hand-sewn anastomosis. There were no significant differences between the patients who underwent the two procedures in terms of age and body weight. Small intestinal atresia was the most common diagnosis (stapled 61.5%, hand-sewn 54.7%) followed by stoma (stapled 7.7%,

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