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Ad libitum feeding after surgery for pyloric stenosis

SHORT REPORT

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Background

Pyloric stenosis is one of the most common reasons for surgery in infants. Standard practice has traditionally been to gradually increase feeding volumes postoperatively. In 2018, Oslo University Hospital, Ullevål introduced ad libitum feeding following surgery for pyloric stenosis. We aimed to investigate whether the new feeding regimen affected the frequency of postoperative complications and length of hospital stay.

Material and method

A retrospective study of children who underwent surgery for pyloric stenosis at Oslo University Hospital, Ullevål in the period 2004–2021. Data were collected on sex, age, birth weight, comorbidities, feeding regimen, in addition to perioperative and postoperative data.

Results

We included 210 patients in the study, including 188 boys. A total of 47 patients received ad libitum feeding postoperatively, while feeding volumes were gradually increased in 163 patients. The groups were similar in terms of sex, age, birth weight and comorbidity. There were no significant differences in postoperative complications, reoperations, readmissions or late complications between the groups. Postoperative length of hospital stay was significantly shorter in the group that received ad libitum feeding compared to the group whose feeding was gradually increased (2.7 vs. 3.7 days, $p < 0.001$).

Interpretation

A shorter hospital stay following surgery for pyloric stenosis was observed following the introduction of ad libitum feeding, with no increase in the incidence of complications. This may be attributed to changes in the feeding regimen, changes in the surgical technique, or temporal factors.

Hypertrophic pyloric stenosis is one of the most common reasons for surgery in infants. The diagnosis is typically made between three weeks and three months of age (1, 2). Treatment involves surgically splitting the thickened pylorus muscle, known as pyloromyotomy (1). After surgery, regurgitation and vomiting can make it difficult to achieve full feeding volumes (1). Gastric peristalsis has been reported to take approximately 24 hours to normalise postoperatively (3, 4). In order to prevent postoperative vomiting, the routine in our department has been to give small feeds, which are gradually increased according to a pylorus feeding protocol. Feeding volumes have been measured either by bottle or by weighing the infant before and after breastfeeding. The increase in volume has been determined individually by the surgeon responsible.

However, several studies have shown that ad libitum feeding allows infants to reach full feeding volumes quicker, ultimately shortening hospital stays (1, 4). Unrestricted oral intake after surgery for pyloric stenosis was therefore introduced in our department in June 2018. This decision was based on a literature review that found ad libitum feeding did not increase the risk of complications, could reduce parental frustration and shorten the time to full feeding volumes (5). The aim of our study was to examine postoperative complications and length of hospital stay after the introduction of this new feeding regimen.

Material and method

We previously published a study on infants with pyloric stenosis who underwent surgery at Oslo University Hospital, Ullevål between 2004 and 2016 (6). This retrospective study also includes patients operated on for the same condition in the period 2017–2021.

During the operation for pyloric stenosis, a nasogastric tube was surgically inserted. A nasogastric tube was used to actively measure gastric aspirate volume and to administer postoperative feeds (enteral nutrition) until the infant could achieve full feeding volumes from breastfeeding or bottle feeding.

Patients were divided into two groups based on their postoperative feeding regimen: ad libitum feeding or gradually increased feeding volumes. In the ad libitum feeding group, the gastric tube was removed shortly after surgery, allowing the infant to self-regulate their feeds. In the other group, the gastric tube remained in place after surgery, and feeding was increased gradually

according to the pylorus feeding protocol. The infant's stomach was actively aspirated before each feed, and the feeding progression was determined based on the volume of gastric aspirate or vomit.

Sex, age, birth weight and comorbidity, perioperative and postoperative data, including incision type, antibiotic prophylaxis, intraoperative complications, postoperative complications and reoperations, were collected from electronic medical records. Comorbidity was defined as any additional diagnosis (Table 1). All types of complications were categorised according to the Clavien-Dindo classification (7).

Table 1

Characteristics of 210 infants who underwent surgery for pyloric stenosis at Oslo University Hospital, Ullevål between 2004 and 2021, categorised by postoperative feeding regimen. Values are presented as number (%) unless otherwise specified.

	Gradually increased feeding (*n*= 163)	Ad libitum feeding (*n*= 47)
Sex, no. of boys (%)	144 (88)	44 (94)
Median age in days at time of diagnosis (range)	32 (5–155)	35 (12–77)
Average birth weight in grams (range)	3 395 (1 520–4 936)	3 524 (2 059–4 510)
Average admission weight in grams (range)	4 003 (2 130–6 000)	4 184 (2 880–6 170)
No. with comorbidity (%)[1]	42 (26)	13 (28)
No. who received perioperative antibiotics (%)	110 (67)	47 (100)
Median surgery time in minutes (range)	30 (12–84)	33 (24–79)

[1]Includes hyperbilirubinemia, ventricular septal defect, atrial septal defect, prematurity, small for gestational age, cystic kidney disease, gastroesophageal reflux, hip dysplasia, seizures, previous ileus surgery, pulmonary stenosis, anaemia, dysmelia, inguinal hernia, microtia, neonatal sepsis, laryngomalacia, omphalitis, withdrawal symptoms, cow's milk protein allergy and requirement for CPAP after birth.

The statistical analyses were performed using SPSS version 29, and $p < 0.05$ was considered statistically significant. Continuous variables were compared between groups using t-tests or the Mann-Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test. Linear regression analysis was performed on variables that predicted postoperative length of hospital stay.

The study was approved by the data protection officer.

Results

We identified 210 patients who underwent surgery for pyloric stenosis at Oslo University Hospital, Ullevål in the period 2004–2021. Of these, 188 were boys (90 %). A supraumbilical incision was made in 192 patients, while 18 patients had a subcostal incision. A total of 163 patients (78 %) had their feeding gradually increased and 47 (22 %) received ad libitum feeding. Seven patients who underwent surgery after June 2018 had their feeding gradually increased, and this was at the surgeon's request shortly after the new feeding protocol was introduced.

There were no significant differences between the groups in terms of sex distribution, age, birth weight, admission weight or comorbidities (Table 1). Perioperative complications occurred in 13 patients (8 %) in the group whose feeding was gradually increased (Table 2). These included skin tears, serosal tears, mucosal perforation and aspiration. The postoperative length of hospital stay was significantly shorter in the group receiving ad libitum feeding compared to the other group, with an average of 2.7 days vs. 3.7 days, respectively ($p < 0.001$). Girls had a shorter postoperative hospital stay than boys (3.0 days vs. 3.6 days, $p = 0.050$). Patients with peri- and postoperative complications had longer hospital stays than those without such complications (4.6 days vs. 3.4 days, $p = 0.002$ and 4.5 days vs. 3.4 days, $p < 0.001$). Postoperative complications occurred in 19 patients (9 %) and included wound infection, urinary retention, hypoxia, upper respiratory tract infection, haematoma and respiratory problems. In the group receiving gradually increased feeds, three patients were reoperated on due to wound infection/abscess (two patients) and infected haematoma (one patient). Three patients were reoperated on in the ad libitum feeding group due to a postoperative infection/abscess.

Table 2

Complications, reoperations and readmissions in 210 children who underwent surgery for pyloric stenosis at Oslo University Hospital, Ullevål in the period 2004–21.

	Gradually increased feeding (n = 163), n (%)	Ad libitum feeding (n = 47), n (%)	P-value
Perioperative complications	13 (8)	0 (0)	0.04
Postoperative complications (< 30 days)	16 (10)	3 (6)	0.58
Reoperations	3 (2)	3 (6)	0.13
Readmissions	9 (6)	0 (0)	0.21

	Gradually increased feeding (n = 163), n (%)	Ad libitum feeding (n = 47), n (%)	P-value
Late complications (> 30 days)	1 (1)	0 (0)	1.00

Linear regression analysis revealed the following independent predictors for postoperative length of hospital stay: ad libitum feeding was associated with a shorter postoperative length of hospital stay ($p < 0.001$), girls had shorter stays than boys ($p = 0.018$), while perioperative complications ($p = 0.002$) and postoperative complications ($p < 0.001$) were associated with longer stays.

We conducted additional analyses after excluding the seven patients who received gradual feeding after the introduction of the new feeding regimen, with no significant changes to the results. We also compared the results before and after the change in the feeding regimen according to the intention-to-treat (ITT) principle. We found almost the same results and no changes in the conclusions.

Discussion

There has been a tradition of gradually and carefully increasing feeding volumes after surgery for hypertrophic pyloric stenosis. Our results indicate that there is no increased risk when postoperatively feeding this patient group ad libitum compared to gradually increasing feeding volumes. This is consistent with recent literature (1, 2, 4, 8). In our study, patients who received ad libitum feeding postoperatively had a shorter postoperative length of hospital stay than those whose feeds were gradually increased. A multivariate analysis showed that the feeding regimen was an independent predictor of length of hospital stay, with children who received ad libitum feeding having a shorter stay than those whose feeds were gradually increased. Since we still do not discharge patients until they have achieved nearly full feeding volumes, this aligns with the fact that patients who received ad libitum feeding postoperatively achieved full feeding volumes sooner than those whose feeds were gradually increased.

There were no significant differences between the feeding groups in terms of postoperative complications. Nine per cent of the patients experienced postoperative complications. This is consistent with other findings in the literature, where the complication rate varies between 4.6 % and 12 % (2). Patients with peri- or postoperative complications had, as expected, a longer hospital stay after surgery. A surprising finding was that boys remained in hospital postoperatively longer than girls, which has not been reported in the literature.

Vomiting is common after surgery for pyloric stenosis and occurs in up to 90 % of children (2, 4). In our previous study, we found transient vomiting in 60 % (6). Ad libitum feeding has been associated with more vomiting postoperatively than gradually increasing feeds, and this can cause more stress and a sense of insecurity in parents (1, 2, 4, 9). Several studies show that increased vomiting

postoperatively does not increase the risk of morbidity or readmission (1, 4, 9). The significance of vomiting after surgery for pyloric stenosis can therefore be downplayed (2, 4). It is important to provide good information to parents before the surgery and offer reassurance about the situation.

The greatest strength of this study is the inclusion of all patients who underwent surgery for pyloric stenosis at Oslo University Hospital, Ullevål over an 18-year period. The study has the limitations that are inherent in retrospective non-randomised studies. We found that several factors can affect length of hospital stay after surgery for pyloric stenosis: the feeding regimen, peri- and postoperative complications, and the sex of the patient. Period effects, changes in surgical techniques and altered use of antibiotics can also have an impact.

The article has been peer-reviewed.

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