Case reports

Enterization of the dural patch

An experimental study

C. H. Pappis, M. Z. Kaïris, and G. H. Willital

Department of Paediatric Surgery, Pendeli Children’s Hospital, Athens, Greece

Abstract. Experimental neogut production was achieved in dogs. After 90% enterectomy, an artificial opening on the antimesenteric border of the intestinal remnant was patched with lyophilized human dura. The internal surface of the patch was completely covered by neomucosa within 8 weeks. Histological and morphometric studies showed that the structure of the newly formed mucosa was similar to that of the neighboring mucosa. The submucosal tunica muscularis started regenerating after the 14th week post-patching. Enterization of the dural patch contributes positively to the management of small bowel syndrome (SBS), as evidenced by an increase in body weight. This increase is highly significant statistically (P<0.001) in the animals with dural patch as compared to control animals. The slower transit time of intestinal contents after patching and the compensatory adaptive processes also result in increasing body weight.

Key words: Massive enterectomy – Short bowel syndrome – Dura mater graft – Dural transplantation

Introduction

The increased absorptive surface of the intestinal remnant after massive bowel resection may be of great clinical significance in the treatment of short bowel syndrome (SBS). Production of neomucosa with absorptive capacity has been achieved experimentally by patching the artificially constructed opening of the antimesenteric border of the small bowel remnant with intestinal serosa [1–3, 5, 6], a vascularized abdominal wall pedicle flap [9], or prosthetic material [8, 12, 13]. These patching procedures have inherent disadvantages, which may cause postoperative complications. The successful use of lyophilized human dura mater in the management of many congenital defects (diaphragmatic hernia [7, 10, 14, 16], gastroschisis [4, 15], etc.) and knowledge of its physical properties [10] have led us to employ it as patching material to produce neomucosa in experimentally induced SBS.

Materials and methods

Twenty-eight mongrel dogs, mean age 13.2±4.4 weeks and mean preoperative weight 4592±1553 g underwent 90% enterectomy. Equal lengths of jejunum and ileum were left after resection. A single-layer inversed end-to-end anastomosis was made using interrupted 4-0 silk sutures. The 28 puppies were classified in five groups. The first group consisted of 2 enterectomized puppies as controls. The second group included 5 dogs in which the antimesenteric border of the jejunal remnant was opened and reclosed 4 weeks after massive intestinal resection. The third group comprised 5 dogs in which the above procedure (enterotomy) was done in the ileal remnant. The fourth group included 8 puppies in which the opening on the antimesenteric border of the jejunal remnant was patched with lyophilized human dura, mean length 55±23 mm and mean width 22.5±4.6 mm 4 weeks postenterectomy. In the fifth group, the same patching procedure was performed in the ileal remnant of 8 puppies. The mean length of the dural graft was 42.5±9 mm and the mean width 25±5 mm. The dural graft was fixed using interrupted or continuous 4-0 silk sutures from the intestinal wall to the graft. The surviving dogs were killed 20 weeks after the massive enterectomy.

To evaluate the results of the experiment, the following parameters were studied: (1) clinical development of the puppies after enterectomy and patching or enterotomy; (2) body weight prior to each procedure; (3) compensatory adaptive
changes of the intestinal remnants (length and width); (4) intestinal transit time of gastrografin before and after the procedures; (5) histological findings of enteral transformation of the dural patch. Statistical analysis was done using the unpaired and/or paired Student's t-test.

Results

All experimental animals tolerated the 90% jejunal and ileal resection well. They were generally fed by mouth approximately 2 h after awakening, and the first diarrheal bowel movement occurred some 12 h later. All animals developed a diarrheal syndrome, with 6–8 diarrheal bowel movements daily in the early postoperative period and subsequently 3–4 semi-diarrheal stools per day. Anorexia and vomiting were noted after the jejunal patch procedure. In these cases, parenteral feedings and antibiotics were given for symptoms of functional intestinal obstruction or peritonitis.

Mortality

Of the 28 experimental animals, 11 (39%) died postoperatively. One dog died in the early postoperative period following enterectomy, and 8 of the remaining 10 animals (all in the fourth group) died after patching of the jejunal remnant. The deaths of these 8 dogs were due to functional intestinal obstruction, which was attributed to interruption of the intestinal propulsion wave and subsequent peritonitis following partial or complete detachment of the graft; there was no graft rejection however.

Body weight

The mean body weights of each group of animals are recorded in Fig. 1. The animals were weighed before the first (90% enterectomy), second (enterotomy or patch) and third (sacrifice) procedures.

After massive enterectomy, all experimental animals lost 13%–25% of their preoperative weight. The mean weight of the resected bowel was 200 g (range 180–250 g). At the time of the second procedure the animals had not yet regained their initial preoperative weights. The weight differences between the first and second intervention are not statistically significant among the four groups of dogs (II to V) on the unpaired t-test but are significant on the paired t-test (range: $P<0.01-0.001$).

The mean weight of the dogs prior to death 20 weeks post enterectomy showed an increase over the initial preoperative weight. The increase is not statistically significant for any group except group 5 on the unpaired t-test, but the paired t-test demonstrates a statistically significant difference for group 2 ($P<0.05$) and group 5 ($P<0.001$).

Based on the above results, we assume (a) that enterotomy of the jejunal remnant (group 2) affects the higher myoelectric activity of the jejunum, causing slowing of transit time, and (b) a dural patch of about 10 cm$^2$ at the terminal ileum (group 5) leads to increases in body weight. This may be attributed to compensatory adaptation, increased transit time, and increased absorptive capacity (mucosal regeneration).

Measurement of length and width of the small intestine

Table 1 shows the mean length of jejunum and ileum or their remnants at the three laparotomies and before each surgical procedure or before death in the five groups of experimental animals. Measurements were made using a premeasured umbilical tape along the antimesenteric border of the small intestine. Lengthening of the remnants (> SD) apparent is at the second procedure and, especially, prior to death. This lengthening is statistically significant to highly significant in all groups as compared with the length of the remnants after 90% enterectomy.

Table 2 reflects the mean width of jejunum (2–3 cm peripherally to Treitz's ligament) and ileum (1–2 cm centrally from the ileocolic valve)