A comparison of prosthetic materials used to repair abdominal wall defects

Abstract

Large abdominal wall defects may require a prosthesis for closure. The aim of our study was to identify the best material for abdominoplasty in pediatric patients. One hundred twenty-eight Wistar KY strain male rats (3 weeks old) were used. All animals underwent celiotomy via a midline skin incision. They were divided into seven groups as follows: the animals in groups 1 through 6 underwent full-thickness abdominal wall excision 3 cm in diameter. The animals in group 1 underwent primary closure. In groups 2 through 6 the defect was closed with prosthetic material. In Group 7, a sham operation was performed. Daily weights were measured. The animals were killed after 3 and 9 weeks. Adhesion scores were assigned for each group. Vicryl mesh resulted in the fewest adhesions and had no effect on weight gain in the developing rats.

Key words

Abdominal wall defects · Vicryl mesh · Adhesion score

Introduction

It is often difficult to primarily repair the abdominal wall defect (AWD) in patients with gastroschisis or a large omphalocele. Many procedures and synthetic membranes have been used [1–12], however, outcomes have been poor because of adhesions, fistulae, abdominal wall herniation [13], and prosthesis infection. The incidence of these complications is particularly high when non-absorbable materials are used. Suitable synthetic materials for abdominoplasty have subsequently been developed. Vicryl and Gore-tex have been evaluated for the repair of AWDs, but have not been studied in pediatric patients. The purpose of this study was to identify the most suitable synthetic material for abdominoplasty in children.

Materials and methods

In this experiment, 128 Wistar KY strain male rats (3 weeks old, 45 to 55 g) were used. Under ether anesthesia, the skin and subcutaneous tissue were dissected from the abdominal muscles and fascia through a 4-cm midline incision; full-thickness abdominal wall was then excised. Standard aseptic precautions were taken; the abdominal wall was shaved and prepared using 0.5% chlorhexidine in alcohol. The defects in group 1 were closed primarily. In the other groups, the defect was repaired by suturing a 2-cm² patch of prosthetic material to the fascial edge with a 4-0 running polypropylene suture. The animals were divided into five groups according to the prosthesis used (Fig. 1): group 2: Vicryl mesh; group 3: Gore-tex sheet; group 4: Prolene mesh; group 5: Marlex mesh; and group 6: Dacron mesh (Fig. 2). In addition, 9 rats underwent a sham operation (group 7).

At 3 and 9 weeks, the rats were evaluated for adhesions between the synthetic material and the abdominal organs (adhesion score). In addition, animal development and complications were noted. A numerical score was assigned at autopsy for the degree of adhesion formation as described by Smith et al. [14]. These values were subsequently averaged within each group. A resultant adhesion index was determined: grade 0: no adhesions; grade 1: filmy adhesions; grade 2: definite bowel or omental adhesions; and grade 3: dense bowel adhesions to the patch.

The rate of weight gain was recorded. Differences between the groups were assessed for statistical significance using Student’s t-test. The confidence intervals were calculated with the appropriate P value from the standard error of the means of the two groups.

Results

Only 2 of 11 rats in group 1 died; all other animals were available for study. At 3 weeks the adhesion score was
1.3 ± 0.8 in group 1 (n = 11), 1.5 ± 1.2 in group 2 (n = 9), 2.1 ± 0.8 in group 3 (n = 9), 1.9 ± 1.2 in group 4 (n = 9), 1.9 ± 0.8 in group 5 (n = 9), 1.9 ± 0.7 in group 6 (n = 9), and 0.2 ± 0.4 in group 7 (n = 9). There was a significant difference between groups 1 and 3. The Gore-tex sheet appeared to have the highest association with adhesion formation (Fig. 3).

At 9 weeks, the adhesion score was 0.4 ± 0.5 in group 1 (n = 9), 1.0 ± 0.5 in group 2 (n = 9), 1.9 ± 0.8 in group 3 (n = 9), 1.8 ± 1.0 in group 4 (n = 9), 1.8 ± 0.8 in group 5 (n = 9), 1.9 ± 0.8 in group 6 (n = 9), and 0.0 in group 7 (n = 9). Definite adhesions were found in groups 3, 4, 5, and 6 (Fig. 4). Thus, the non-absorbable materials were all associated with adhesions. In Group 2, the Vicryl mesh had already been absorbed; a very thin membrane covered the abdominal viscera (Fig. 5). There were fewer adhesions in this group compared to groups 3, 4, 5, and 6. No adhesions were found in group 7.

The adhesion score of group 2 was not significantly different from that of group 1. In 44% of the animals in group 3 the prosthetic material was exposed. The rate of weight gain was 4.76 ± 0.49 in group 1, 5.66 ± 0.21 in group 2, 5.19 ± 0.33 in group 3, 4.83 ± 0.44 in group 4, 4.88 ± 0.26 in group 5, and 4.99 ± 0.33 in group 6. There were significant differences between groups 2 and