Effect of an Autogenous Free Fat Graft on Hemilaminectomy Defects in Dogs

Junichiro SHIMIZU1) Maiko KOGA3), Miori KISHIMOTO1), Ki-Ja LEE1), Toshiroh IWASAKI3), Yoh-Ichi MIYAKE1) and Kazutaka YAMADA1)*

1)Department of Clinical Veterinary Science, Obihiro University of Agriculture and Veterinary Medicine, Hokkaido 080-8555 and 2)Department of Veterinary Internal Medicine, Tokyo University of Agriculture and Technology, Tokyo 183-8509, Japan

(Received 8 April 2009/Accepted 17 May 2009)

ABSTRACT. The purpose of this study was to evaluate the effect of an autogenous free fat graft (FFG) on hemilaminectomy defects. Hemilaminectomy was performed at three levels in three beagles, and each defect was designated as a control site or a site treated with one of two different sizes of FFG. Subsequently, longitudinal computed tomography scanning and histopathological examination were performed. As a result, no postoperative dural adhesion was recognized at the sites where FFGs were placed regardless of the size of the laminectomy. Moreover, there was no compression of the spinal cord by the FFG. Therefore, it appears that postoperative dural adhesion was controlled by the FFG and that the possibility of FFG migration into the spinal canal is low in hemilaminectomy. In conclusion, placement of an FFG over the defect was considered useful for preventing complications in hemilaminectomy.

KEY WORDS: adhesion, autogenous free fat graft, canine, hemilaminectomy, migration.

Laminectomy is frequently selected as the surgical treatment for thoracolumbar intervertebral disc diseases. The aim of laminectomy is to extract the herniated intervertebral disc material from the defect by the excision of a part of the vertebral arch [10]. However, it has been reported that there is a possibility of fibrosis around the defect and adhesion between the exposed dura mater and surrounding tissue [7]. Furthermore, this adhesion might lead to pain at the surgical site and worsening of clinical symptoms [3]. Placement of an autogenous free fat graft (FFG) over the defect to act as a cover that separates the exposed dura mater and surrounding tissue has been reported as an effective solution to this problem. On the other hand, it has also been reported that migration of the FFG into the epidural space aggravates the neurological symptoms [5, 12]. However, in these reports concerning the complications of laminectomy and the usage of FFG, only dorsal laminectomy was performed, and there have been no reports concerning hemilaminectomy to date. Hemilaminectomy is the most frequently selected surgical procedure for thoracolumbar intervertebral disc disease in dogs [4]. Therefore, in the present report, the relationship between the exposed dura mater and the surrounding tissue of hemilaminectomy defects was investigated in dogs. The relationship was evaluated by computed tomography (CT) and histopathological examinations.

MATERIALS AND METHODS

The experiments were conducted with the approval of the animal use and care administrative advisory committee of the Obihiro University of Agriculture and Veterinary Medicine. Three clinically normal beagles (spayed females, littermates) were used for the experiment. The age of all the dogs was 10.7 years, and the mean body weight was 10.3 kg (range: 9.8–11.2 kg). Hemilaminectomy was performed at three levels in each dog. Each defect was subsequently designated as a control site or a site treated with one of two different sizes of FFG. Immediately after the operation, CT scanning was performed on the operative area. Myelography was then performed followed by a further CT scan. Longitudinal CT scanning pre- and post-myelography was performed on days 14, 28, 42 and 56 after the operation. After the CT scan on the 56th day, the dogs were euthanized, and histopathological examination of the dura mater and surrounding tissue was performed. The details of the protocol are described as follows.

Surgical procedures: The dogs were anesthetized by intravenous injection with propofol (8.0 mg/kg, Rapinovet®; Schering-Plough Animal Health, New York, USA) and maintained under anesthesia using inhalational isoflurane/O2 (Forane®, Abbott Japan, Osaka, Japan) and cefazolin sodium (30 mg/kg, Racenazolin®, Maruko Pharmaceutical, Aichi, Japan) were injected subcutaneously. Hemilaminectomy was performed using the standard method on the left side of T13-L1, the right side of L1-L2 and the left side of L2-3. All defects were designed to be the 5 mm × 10 mm and were measured using a ruler. The FFG was obtained from the superficial layer of the surgical site and formed to a thickness of 5 mm. Two different sizes of FFG were utilized as follows: 7 mm × 14 mm (small FFG) and 10 mm × 20 mm (large FFG). In consideration of the influence of anatomical location on the experimental result, the sites of FFG placement and no placement (control) were evenly distributed as shown in Table 1.

CT examination: To observe the state of the FFG, CT scanning of the thoracolumbar site was performed. In this
examination, a multi detector row CT scanner (Asteion™ Super 4, Toshiba Medical Systems, Tokyo, Japan) was used. Additionally, to evaluate the presence of compression of the spinal cord by the FFG or surrounding tissue, myelography was performed immediately after CT scanning. After myelography, CT scanning was performed again.

Postoperative procedures: Meloxicam (0.2 mg/kg) was subcutaneously injected daily via a single injection for the first 3 postoperative days. In addition, cefazolin sodium (30 mg/kg) was subcutaneously injected twice daily as an antibiotic for the first 7 postoperative days. All dogs were maintained in the same type of cage. Observation of the dogs’ clinical condition was performed every day during the experimental period.

Analysis of CT images: The intradural area of each cross-section including the defect and the FFG volume were measured on CT images. For measurement of the intradural area, the same section of each CT myelography image was used each time using a bone window. For measurement of the FFG volume, the CT image before myelography was used each time using a soft tissue window. All these measurements were performed by the same observer. From the obtained results, the longitudinal alterations in the intradural area of each cross-section were compared statistically among the control, small FFG, and large FFG, and the longitudinal volume alterations between the small and large FFGs were also compared statistically. For statistical analysis, Tukey’s post-hoc test and the Student’s t test were used, and the minimum significance level was established at 5% probability.

Histopathological examination: The dogs were euthanized by deep anesthesia after CT scanning on the 56th day. At necropsy, the thoracolumbar vertebrae and the surrounding tissue were removed and fixed in 10% formalin solution. Thin sections were prepared at each surgical site using a standard method for histopathological examination. The sections were stained with hematoxylin-eosin and Masson’s trichrome. The degree of fibrosis of the exposed dura mater and adhesion between the dura mater and surrounding tissue were then evaluated microscopically.

RESULTS

Intradural area of each cross-section: The alteration in the intradural area is shown in Fig. 1. During the experimental period, no significant difference in intradural area was confirmed among the small FFG, large FFG and control sites. In addition, no significant change was confirmed in any intradural area over time.

Volume of FFG: The volume alterations in the small and large FFGs are shown in Fig. 2. The volume of the large FFG was significantly larger than that of the small FFG on the operation day and 14 days after the operation. From 28 days after the operation, there was no significant difference in volume between the small and large FFGs. *: p<0.05.

Table 1. Procedure for each defect

<table>
<thead>
<tr>
<th>Dog No.</th>
<th>Operative site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T13-L1 (left side)</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
</tr>
<tr>
<td>2</td>
<td>Small FFG</td>
</tr>
<tr>
<td>3</td>
<td>Large FFG</td>
</tr>
</tbody>
</table>

Control: No treatment. Small FFG: 7 mm × 10 mm FFG. Large FFG: 10 mm × 20 mm FFG.
Histopathological findings: At the control sites, fibrous adhesion was found between the exposed dura mater and surrounding tissue in all 3 dogs. However, the adhesion was localized in part of the exposed dura mater (Fig. 3). Additionally, dural thickening with fibrosis and fibrotic surrounding tissue were recognized in all 3 dogs. At small FFG sites, mild dural thickening was found in 2 of the 3 dogs. However, the fat tissue remained sufficient to separate the dura mater from the surrounding tissue at all small FFG sites. Therefore, no adhesion between the dura mater and surrounding tissue was found, as in the case of the small FFG sites (Fig. 5).

Clinical conditions: At all surgical sites, the skin, subcutis, fascias and muscle recovered well. During the experimental period, no change was found in the clinical condition of any of the dogs.

DISCUSSION

In dorsal laminectomy, dense adhesion has previously been found recognized between the exposed dura mater and surrounding tissue at defects that have not been covered with materials such as FFG [1, 2, 7, 9]. In the present study, fibrous adhesion was also found at the control sites where no FFG was placed over the defects. This result indicates that it is necessary to consider postoperative dural adhesion even in hemilaminectomy. On the other hand, there was no adhesion at the sites where an FFG was used. These results confirm that FFG prevents the dural adhesion of hemilaminectomy defects.

Recently, an FFG twice the size of the defect has been recommended as the appropriate size for hemilaminectomy [10]. However, this recommendation is based on a past report concerning dorsal laminectomy [12]. In this study, it was histopathologically confirmed that there was no difference in preventive effect against postoperative dural adhesion regardless of the size of the FFG (small FFG, double the area of defect; large FFG, 4 times the area of the defect). Furthermore, as a result of CT examination, the FFG was confirmed to reduce in size over time, and there was no significant difference in volume between the small and large FFGs at 28 days after the operation. Therefore, it appears that the physical effect of covering the defect became similar over time even if a different sized FFG was used. Consequently, the preventive effect against postoperative dural adhesion conveyed by an FFG with an area twice that of the defect was considered to be sufficient, even in hemilaminectomy.

In regard to the disadvantages of FFG, it has been reported that the FFG sometimes migrate into the epidural space and that neurological symptoms are aggravated by compression of the spinal cord [5, 12]. However, only dorsal laminectomy was performed in these previous studies.

In conclusion, placement of an FFG over the defect was considered useful for preventing complications in hemilaminectomy.
REFERENCES


