Reconstruction with latissimus dorsi, external abdominal oblique and cranial sartorius muscle flaps for a large defect of abdominal wall in a dog after surgical removal of infiltrative lipoma

Yu-Ching FENG1), Kuan-Sheng CHEN1,2) and Shih-Chieh CHANG1,2)*

1)Veterinary Medical Teaching Hospital, College of Veterinary Medicine, National Chung Hsing University, 250 Kuo-Kuang Road, Taichung 40227, Taiwan
2)Department of Veterinary Medicine, College of Veterinary Medicine, National Chung Hsing University, 250 Kuo-Kuang Road, Taichung 40227, Taiwan

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ABSTRACT This animal was presented with a large-sized infiltrative lipoma in the abdominal wall that had been noted for 4 years. This lipoma was confirmed by histolopathological examination from a previous biopsy, and the infiltrative features were identified by a computerized tomography scan. The surgical removal created a large-sized abdominal defect that was closed by a combination of latissimus dorsi and external abdominal oblique muscle flaps in a pedicle pattern. A small dehiscence at the most distal end of the muscle flap resulted in a small-sized abdominal hernia and was repaired with cranial sartorius muscle flap 14 days after surgery. The dog was in good general health with no signs of tumor recurrence after 18 months of follow-up.

KEY WORDS: abdominal wall defect, dog, infiltrative lipoma, muscle flaps

NOTE Surgery

An 8-year-old, intact male, mixed breed dog was presented with intermittent hematuria and a mass in the right inguinal region for 4 years (Fig. 1A). Concurrently, calculi in the urinary bladder were seen by radiographic examination (Fig. 1B). Subsequently, two large stones were removed by cystotomy, and incisional biopsy of the abdominal mass was performed for histologic examination. Histopathologic diagnosis was lipoma. However, based on the history and anatomic site of this mass, diagnosis of a suspected lipoma with infiltration to abdominal wall musculature was made. Subsequently, the patient was referred to the Veterinary Medical Teaching Hospital, National Chung Hsing University for further evaluation. On presentation, the dog was bright, alert and responsive with normal vital parameters. A large-sized subcutaneous mass in the right inguinal region was found. It was firm on palpation, with ill-defined demarcation and was firmly fixed with the underlying abdominal wall. This mass measured 15.1 × 8.5 × 5.5 cm in size. Palpation of peripheral lymph nodes displayed unremarkable findings. A complete blood count and serum biochemistry were performed, and the results were within normal reference limits. A computerized tomography (CT) scan (Alexion, Toshiba Medical Systems Corporation, Otawara, Japan) was scheduled to further assess the extent and margins of this mass, and for surgical planning.

The dog was premedicated with detomidine (65 μg/m², IV) and midazolam (0.2 mg/kg, IV) and induced with propofol (1 mg/kg, IV). Anesthesia was maintained with isoflurane after intubation. The dog was placed in sternal recumbency. A CT scan was performed from the level of T8 to the hip joint. Following the plain CT scan, 2 ml/kg of contrast medium (Optiray, GE Healthcare, Cork, Ireland) was administered, and the CT scan was repeated. The CT scan revealed that there was a homogeneous hypoattenuating mass approximately 15.4 × 12.7 × 9.1 cm in the right inguinal region with a mean hounsfield unit of ~130 which was compatible with normal subcutaneous fat tissue. The mass had infiltrated to the musculature of the abdominal wall, including the external abdominal oblique, internal abdominal oblique, transversus abdominis and rectus abdominis muscles. The muscles were fragmented with a mottle appearance. Contrast images revealed that two arteries (right cranial abdominal and deep circumflex arteries) supplied the mass, but the mass did not show an enhanced contrast. The urinary bladder was displaced to the left by the mass (Fig. 1C and 1D).

Ten days after the CT examination, surgical removal of this infiltrative lipoma of the abdominal wall was performed with 1- to 2-cm margins. The dog was premedicated with detomidine (125 μg/m², IV) and midazolam (0.2 mg/kg, IV) and induced with propofol (1 mg/kg, IV). An endotracheal tube was placed. Anesthesia was maintained with isoflurane. The dog was placed in left lateral recumbency. An “L-shaped” skin incision was made. A caudal incision line was conducted from the cranial border of the iliac wing to the inguinal region, and a lateral incision was made from the inguinal region to the 9th rib. Skin and subcutaneous...
adipose tissues were bluntly dissected till exposure of the external abdominal oblique muscle was achieved. A large mass beneath this muscle was seen. The external abdominal oblique, internal abdominal oblique, rectus abdominis and transversus abdominis muscles were severed with 1–2 cm surgical margins of normal tissues. Resection of the abdominal wall was performed with a bipolar vessel sealing device (LigaSure small jaw instrument, Covidien, Plymouth, MN, U.S.A.) and a monopolar electrocautery while carefully distinguishing normal fat from the tumor. Visceral organs were exposed after mass removal (Fig. 2A).

The lateral skin incision was further extended to the level of the 4th rib. Skin and subcutaneous tissue were bluntly dissected to expose muscles. The latissimus dorsi muscle flap was harvested by transecting it at the level of the 6th rib cranially and below the transverse process of the spine dorsally. The cranial portion of the external abdominal oblique muscle (white triangle) was severed from its rib attachment. Both muscles were undermined and elevated till their attachment to the 11th rib and reversed 180 degrees to completely cover the large defect. C, The latissimus dorsi (white asterisk) and external abdominal oblique muscle (white triangle) flaps were sutured with the residual abdominal wall and hypaxial muscle with 2–0 polydioxanone, simple interrupted pattern.
Anesthesia was maintained with isoflurane. The dog was placed in lateral recumbency. The hernia was approached by blunt dissection of the subcutaneous tissue of the area. The postoperative pain management included CRI of the same drugs for 2 days and then the same dosage of gabapentin and tramadol for 9 days.

Fourteen days after surgery, a second surgery was performed to repair a small-sized abdominal hernia that developed at the most caudal dorsal aspect of the muscle flap, and the partial skin necrosis in the inguinal region (Fig. 3A). The dog was premedicated with dexmedetomidine (65 μg/m², IV) and midazolam (0.2 mg/kg, IV) and induced with propofol (1 mg/kg, IV). An endotracheal tube was placed. Anesthesia was maintained with isoflurane. The dog was placed in left lateral recumbency. The hernia was approached by incising the skin of the previous surgical incision line and blunt dissection of the subcutis. Dehiscence at the caudal dorsal end of the latissimus dorsi muscle flap and herniated intestine could be seen. The rest of the muscle flap healed well (Fig. 3B). Another incision was made from the inguinal region to the cranial stifle along the cranial edge of the thigh. The cranial sartorius muscle was elevated and severed from its distal insertion. It was mobilized proximally to the level of the vascular pedicle and reversed 180 degrees to cover the small-sized hernia. After irrigation and restoration of the herniated intestine, the hernia was closed by suturing the distal portion of the cranial sartorius muscle flap to the defect with 2–0 polydioxanone in a simple interrupted pattern (Fig. 3C). Penrose drains were placed, followed by routine closure of the subcutis and skin. The postoperative pain management included CRI of the same drugs for 2 days and then the same dosage of gabapentin and tramadol for 9 days.

Twenty-eight days after the first surgery, a third surgery was carried out to revise a small vulnerable area from the previously herniated site. After the dog was routinely anesthetized with the same medication as the previous surgery, positioning was performed in the same way as the previous surgery. Musculature was exposed after skin incision and blunt dissection of the subcutaneous tissue of the area. The muscle flap stayed intact with an area that was thinner than the rest. The thinner musculature was trimmed and sutured. Oral medication after operation included the same dosage of tramadol, gabapentin and cephalexin for 5 days. The dog recovered uneventfully afterwards and was in good general health with no sign of tumor recurrence after 18 months of follow up.

Grossly, the tumor invaded and penetrated through the muscle of the abdominal wall (Fig. 4A). Fragmented muscle could be seen within the tumor on cross section. Histopathological examination of the mass revealed well-differentiated adipocytes infiltrating the skeletal muscle tissue (Fig. 4B). The tumor was excised with clean margins. A diagnosis of infiltrative lipoma was made.

In dogs, infiltrative lipomas are uncommon. Infiltrative lipomas are considered benign, because they do not metastasize. But, as in this case, they are locally invasive and may infiltrate normal muscle, fascia, nerves, myocardium, joint capsules and bone [2, 3, 5, 6]. Infiltrative lipomas are composed of well-differentiated adipose cells that are the same as lipomas. Thus, sometimes, it is impossible to differentiate infiltrative lipomas from lipomas with cytology and histopathology [2]. For those clinically suspected infiltrative lipoma cases, CT is a better tool than radiography to assess the infiltrating nature and extent of this tumor and help make a surgical plan [6]. Except for the cases with prior surgical resection, contrast enhancement will show peripheral to the tumor possibly due to the prior surgery. Administration of intravenous contrast medium has no significant benefit for assessment, because there is no contrast enhancement [6]. However, in a large-sized tumor, such as in this case, contrast CT scan can provide more accurate assessment of vascular involvement.

Complete surgical excision can be curative and results in long-term survival [2], while radiation therapy with measurable disease could only induce either stable disease or partial response and is better served as an adjuvant therapy after incomplete surgical resection [7]. In this case, CT scan was performed to evaluate the extent of tumor and adjacent musculature and plan surgical margins. The result showed that the infiltrative lipoma was amenable to resection though it has affected abdominal wall extensively and required further reconstruction after tumor removal. However, to distinguish an infiltrative lipoma from normal fat tissue is often very difficult during surgery. This may lead to local recurrence rates of 36–50% [2, 5]. In this case, the tumor was excised...
with clean margins. Thus, adjuvant therapy was not recommended.

The use of autologous latissimus dorsi, external abdominal oblique and cranial sartorius muscle flaps with an axial flap pattern respectively to reconstruct the full-thickness of an abdominal wall defect has been described [1, 9]. However, the abdominal wall defect after tumor removal in this case was too large to repair with a single muscle flap. Thus, based on the previous surgical plans, the decision was made to utilize a combination of latissimus dorsi and external abdominal oblique muscle flaps. The latissimus dorsi muscle is a triangular muscle covering the most of the dorsal and some of the lateral thoracic wall in the dog [4]. The dominant vascular pedicle of the latissimus dorsi is the thoracodorsal artery in the proximal portion. Several intercostal arteries supply the dorsal caudal aspect of the muscle, with the intercostal arteries 6, 7, 10, 11 and 12 being the most important [10, 12, 13]. The external abdominal oblique muscle consists of two components, the costal part originates segmentally from the 4th or 5th rib through the 13th rib, while the lumbar part originates in the thoracolumbar fascia along the iliocostalis muscle [1, 4]. The major pedicle artery that supplies the external abdominal oblique muscle is the cranial branch of the cranial abdominal, which supplies the middle zone of the lateral abdominal wall [1]. The use of an axial or island flap pattern would not provide enough coverage of the abdominal defect in this case due to the fact that the mobility of the muscle flaps would be restricted by the pedicle arteries. Thus, a pedicle flap pattern was used. The two major dominant arteries, the thoracodorsal artery and the cranial branch of the cranial abdominal artery, which should be preserved for an axial flap pattern of the latissimus dorsi and external abdominal oblique muscles were transected during flap harvesting and tumor removal. However, both muscles still received blood supply from intercostal arteries, although most of the muscle attachments to the ribs were transected during flap harvesting. The outcome of a combination of the latissimus dorsi and external abdominal oblique muscle flaps was good with only a small dehiscence that resulted in a small-sized abdominal hernia. The dehiscence area was located at the most dorsal caudal end of the flap which received the least blood supply and carried the most tension, making the area prone to dehiscence. The second surgery was performed to repair the abdominal hernia with an axial pattern using a cranial sartorius muscle flap, which is supplied by a single major vascular pedicle. The cranial sartorius muscle flap can be used to cover caudal abdominal hernia and large inguinal hernia [11]. Consequently, the flap healed well with only a small area of weak muscular tension which did not lead to hernia or dehiscence.

Skin necrosis occurred at the most caudal ventral end of the skin incision after the first surgery. The skin necrosis may have resulted from transection of the deep circumflex iliac artery which is the main direct cutaneous vessel that supplies the caudal lateral flank region [8]. Together with extensive undermining and prolonged elevation of the skin during surgery, the most distal region may experience poor blood supply and be prone to necrosis.

The vast majority of muscle flaps have been described with axial or island flap pattern with the pedicle vessels supplying the flap [1, 9, 11]. The mobility and application of these muscle flaps are limited by pedicle vasculature, and these flaps have been used to treat ventral or cranial to mid-abdominal wall defects, not caudal abdominal wall defects [1]. To the best of our knowledge, this is the first application of a latissimus dorsi muscle flap in combination with an external abdominal oblique muscle flap using a pedicle flap pattern to cover such a large-sized abdominal wall defect.
Although the major blood supplies were transected during tumor removal and flap harvesting, the muscle flap healed well with only a minor complication. This technique might be a novel method for repairing large-sized abdominal wall defects that extend to the caudal abdomen.

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