Total scapulectomy for the treatment of chondrosarcoma in a cat

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Case Description—A 10-year-old neutered male domestic shorthair cat was admitted for treatment of a mass affecting the right scapula.

Clinical Findings—A firm soft tissue mass located over the craniolateral aspect of the right scapula was evident during palpation. The mass extended close to the shoulder joint but did not cause lameness of the affected limb.

Treatment and Outcome—Examination of a biopsy specimen obtained from the mass indicated chondrosarcoma. Total scapulectomy was performed to allow wide excision of the tumor. Weight bearing on the operated limb was tolerated 12 hours after surgery. Six months after surgery, limb function was assessed and considered excellent. The owner reported that the cat had its typical amount of activity and was able to jump and play normally. No recurrence of the tumor was evident 6 months after surgery.

Clinical Relevance—On the basis of the functional outcome after surgery, total scapulectomy may be a viable limb-sparing technique for the treatment of local neoplasms in cats. Subtotal scapulectomy has been reported previously, with a good to excellent clinical outcome expected. Total scapulectomy associated with only a fair clinical outcome has been reported previously, which has led to the general recommendation that scapulectomy be performed with preservation of the shoulder joint. The information provided in this report revealed that total scapulectomy can be associated with an excellent outcome in a cat.


A 6.2-kg (13.64-lb) 10-year-old neutered male domestic shorthair cat was referred to our facility for treatment of a mass located on the cranialateral aspect of the right scapula. Incisional biopsy of the mass had been performed prior to referral, and histologic examination of the biopsy specimen revealed chondrosarcoma.

Results of clinical examination at our facility were unremarkable, except for the scapular mass, which was firm, approximately 30 × 40 mm, raised 20 mm above the body surface, and not associated with signs of pain. The tumor did not interfere with limb function or range of motion, and no lameness was observed. Results of routine preoperative biochemical and hematologic analyses were unremarkable. Evaluation of radiographs of the right scapula revealed a large, solitary, proliferative mass located over the cranial border that extended to within 20 mm of the glenohumeral joint (Figure 1). The mass consisted predominantly of soft tissue, with associated amorphous bone proliferation. Evaluation of lateral thoracic radiographs with the lungs inflated for tumor staging did not indicate evidence of overt pulmonary metastasis.

Right total scapulectomy was performed via a lateral approach. A rectangular-shaped incision with rounded corners was made in the skin over the mass; the boundaries of the incision exceeded the size of the mass. The scapula was elevated in a cranioventral direction by transection of the trapezius, omotransversarius, and rhomboideus muscles. These muscles were transected at least 2 cm from the periphery of the mass to obtain sufficient margins. The serratus ventralis muscle was transected close to its origin on the medial aspect of the scapula. The long head of the triceps brachii muscle and the teres minor and teres major muscles were transected close to their origins on the caudal border of the scapula. The 2 portions of the deltoïdus muscle (partes scapularis and acromialis) were transected at the level of the glenohumeral joint. The tendinous portions of the subscapularis, infraspinitus, and supraspinatus muscles were severed a few millimeters proximal to their insertions. The suprascapular and axillary nerves were transected. The coracohumeralis muscle was transected at the level of the glenohumeral joint. The joint capsule and glenohumeral ligaments were incised circumferentially midway between the scapula and humerus. The tendinous portion of the biceps brachii muscle was transected and sutured to the remaining joint capsule of the humerus. The scapula was excised (Figures 2 and 3). The remaining portion of the brachial plexus was identified and preserved.

Reconstruction was performed by fixation of the teres major muscle to the thoracic part of the rhomboideus muscle. The medial aspect of the remaining joint capsule, including a portion of the medial glenohumeral ligament, was sutured to the periosteum of the first rib. The cervical part of the serratus ventralis muscle was sutured to the tendinous portion of the subscapularis muscle. The most cranial part of the rhomboideus muscle was sutured to the deltoideus muscle, and the middle part of the rhomboideus muscle was sutured to the tendinous portion of the teres minor muscle.
The long head of the triceps brachii muscle was then sutured to the remaining portion of the infraspinatus muscle. The head of the humerus was covered via closure of the infraspinatus, supraspinatus, and rhomboideus muscles (Figure 4). All muscle layers were closed with 3-0 monofilament absorbable sutures in an interrupted cruciate pattern. The wound was then closed in a routine manner.

The excised scapula was submitted for histologic examination. The diagnosis of chondrosarcoma was confirmed, and the excision of the entire mass was verified.

Postoperative recovery was uncomplicated. Analgesia was provided initially by administration of a constant rate infusion of ketamine (gradually tapering dose from 1.0 to 0.5 mg/kg/h [0.45 to 0.23 mg/lb/h]) and a constant rate infusion of morphine (0.1 mg/kg/h [0.045 mg/lb/h]) for 18 hours after surgery. Thereafter, analgesia was provided by administration of methadone (0.1 mg/kg, IM, q + h) for the subsequent 24 hours, which was followed by administration of buprenorphine (0.01 mg/kg [0.0045 mg/lb], IM, q 8 h) for 24 hours. Meloxicam (0.1 mg/kg, PO, q 24 h) was administered for 10 days after surgery.

The cat was able to bear weight on the operated limb 12 hours after surgery. The cat was discharged to the care of the owner 3 days later. Exercise was restricted to cage confinement with periods of supervised activity until suture removal at 2 weeks after surgery, which was followed by restriction to only indoor activity for the subsequent 2 weeks.

Six months after surgery, limb function was considered excellent (consistently fully weight bearing during walking and weight bearing on the limb when resting) by use of criteria described elsewhere. The owner reported that the cat had its typical amount of activity and was able to jump and play normally.

Clinical examination was performed 191 days after surgery. No signs of pain were elicited during manipulations.
lation of the operated right forelimb. External rotation of the brachium was observed at rest (<5°) and during walking (5° to 10°). The range of motion of the pseudarthrosis was similar to that of the contralateral shoulder joint in a craniocaudal direction, but increased laxity in abduction was detected (ie, the humerus could be lifted such that it was almost perpendicular [90°] to the chest wall). No signs of tumor recurrence were detected.

Discussion

Chondrosarcoma is one of the most common primary bone neoplasms in cats. Chondrosarcoma in cats is primarily associated with the skeleton, both appendicular and axial, but may also be found extraskeletally. In 1 study, chondrosarcoma was associated with bones in 46 of 67 (69%) affected cats, with 29 (63%) of those cats affected in the long bones and the remaining 17 (37%) affected in the flat bones. In addition, the scapula was the most commonly affected bone (767 [10%] cats). The mean age at diagnosis was 9.6 years, with males being 1.9 times as commonly affected as were females. Metastatic disease was not reported in those 67 cats, and radical surgical excision was associated with long-term control or cure. In the cat of the present report, the tumor extended close to the glenohumeral joint, and wide surgical resection could only be achieved by total scapulectomy or forelimb amputation. No adjuvant chemotherapy was used in the treatment of the cat of the present report because it was not considered an indicated treatment for chondrosarcoma.

The criterion-referenced standard for local management of primary bone tumor is amputation of the affected limb. Limb-sparing surgery has widely been described as an alternative to amputation for local tumor control and is indicated in animals with severe concurrent orthopedic or neurologic disease. Limb-sparing surgery has been used to treat local neoplasia of the radius and ulna, humerus, scapula, pelvis, femur, and tibia, and the functional outcome varies with the location. Most limb-sparing techniques involve replacement of the resected portion of bone with bone grafts, bone transport, or endoprostheses to allow limb function. However, in some animals, partial resection of a bone with a minor role in weight bearing (eg, ulna, fibula, and scapula) may be performed without replacement and still provide satisfactory limb function. This is the case for the scapula. Although the difference between partial and subtotal scapulectomy has not been clearly defined, both have been recommended as preferable to forelimb amputation for the treatment of local scapular neoplasia when appropriate surgical margins are achievable. Except for 1 dog that underwent total scapulectomy and reportedly had only a fair outcome, all animals reported in the literature that underwent subtotal or partial scapulectomy with preservation of the glenohumeral joint had an excellent outcome. In the single previously reported total scapulectomy in a dog, the glenoid tubercle was preserved to aid the fixation of the origin of the tendinous portion of the biceps brachii muscle to the caudal aspect of the joint capsule. In the cat of the present report, there was complete excision of the scapula, without preservation of the glenoid tubercle, and attachment of the medial aspect of the joint capsule and medial glenohumeral ligament to the periosseum of the first rib (glenothoracic suture), rather than reliance on support obtained by direct closure of the muscles over the humeral head and

Figure 3—Photograph obtained after removal of the scapula from the cat in Figure 1. Cranial is to the right and dorsal is toward the top. Structures indicated are as follows: a = Deltoideus muscle. b = Lateral head of the triceps brachii muscle. c = Supraspinatus muscle. d = Infraspinatus muscle. e = Head of the humerus. f = Medial aspect of the joint capsule. g = Long head of the triceps brachii muscle. h = Serratus ventralis muscle. i = Trapezius muscle. j = Rhomboideus muscle.

Figure 4—Photograph following reconstruction of the muscles after removal of the scapula from the cat in Figure 1. Cranial is to the right and dorsal is toward the top. See Figure 3 for key.
scapular remnant, as described elsewhere. Postoperative function after total scapulectomy in this cat was expected to be sufficient such that total scapulectomy was preferable to forelimb amputation. The scapula is united to the thorax by muscles and tendinous attachments. The swing phase of the thoracic limb is provided by the combined movements of the muscular attachments between the thorax and scapula and the glenohumeral joint. During the stance phase of the forelimb, the trunk is supported predominantly by the union of the scapula and serratus ventralis muscle. The deep pectoral muscle also contributes substantially to support the trunk because its insertion on the humerus is dorsal to its origin on the sternum. After subtotal scapulectomy, attachment of the distal portion of the scapula to the trapezius, serratus ventralis, and rhomboideus muscles or direct closure of the muscles over the unsecured scapula has been described for dogs, with no variation in functional outcome. However, after subtotal scapulectomy, the remnant of the scapula, whether secured or only covered by muscles, may contribute to the function of supporting the trunk, and it is unknown whether the deep pectoral muscle alone would be sufficient to support the trunk after total scapulectomy. In the cat of the present report, it was considered preferable to affix the remaining portion of the joint capsule to the thoracic wall to provide support to the trunk combined with closure of the infraspinatus, supraspinatus, and rhomboideus muscles over the humeral head; postoperative limb function was assessed to be excellent. It is unknown whether similar limb function would have been obtained without securing the humeral head to the thorax; however, the authors hypothesize that recovery would have been slower without this support and the fixed fulcrum for the brachium. To the authors’ knowledge, only 1 other case of total scapulectomy has been reported. In a 66-kg (145.2-lb) neutered female Mastiff, the humeral head was not affixed to the thoracic wall other than by coverage of the humeral head with the long head of the triceps brachii muscle, which was sutured to the omotransversarius and trapezius muscles. Limb function was reported to be only fair in that dog, and whether stronger fixation of the humeral head may improve the outcome after total scapulectomy in dogs is unknown. Similarly, it is unknown whether the technique of humeral head fixation described in the cat of the present report, which was accomplished only by use of sutures, would be strong enough for use in dogs, especially large-breed dogs. In the cat of the present report, the slight external rotation observed was likely attributable to fixation of the humeral head in a suboptimal position, which impaired or limited movement. The glenohumeral joint is a ball-and-socket joint between the glenoid cavity of the scapula and the head of the humerus that is capable of movement in any direction. Leaving the humeral head unattached to the thoracic wall may allow a wider, more natural range of motion and avoid this malposition. However, the predominant motions of the glenohumeral joint are flexion and extension in a craniocaudal direction, and excellent limb function should be expected despite fixation of the humeral head. The increased angle of abduction of the brachium as a result of the absence of the glenohumeral joint and medial glenohumeral ligament did not have any clinical consequences. During locomotion, excessive abduction is likely to be opposed by the pectoral muscles, and support of the trunk must be provided by both the pectoral muscles and affixing the humeral head to the thorax (via sutures and coverage with muscles). Time until the cat of the present report was detected as able to bear weight was 12 hours, which is less than that reported for subtotal or partial scapulectomy in dogs (48 hours),. The functional outcome and owner satisfaction after subtotal or partial scapulectomy have been considered good to excellent in the previously reported dogs, with lameness on the operated limb considered undetectable or mild. Postoperative limb function after subtotal or partial scapulectomy reportedly is better in cats than in dogs, and this may be attributable in part to the body weight of cats, which is less than that of dogs. Total scapulectomy has been performed in 1 dog and was associated with a fair clinical outcome. In the cat of the present report, total scapulectomy was performed and resulted in an excellent functional outcome similar to that previously reported after subtotal or partial scapulectomy in cats. This indicated that total scapulectomy for oncological or orthopedic purposes is a viable option in cats.

References


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