

# Principles of Oncologic Surgery

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## Introduction

Surgical oncology in veterinary medicine has improved significantly in recent years. Surgery for neoplasia remains one of the most important methods of treatment for the cancer patient, particularly those with soft tissue tumors. Even when surgery alone cannot affect a cure of a malignant neoplasm, en bloc excision of tumors can significantly prolong the patient's life without causing untoward affects.

Many surgeons have developed more liberal attitudes toward cancer. What was once thought to be unresectable, such as certain oral tumors, may now be routinely excised via radical surgery. When surgical therapy is combined with other modalities, such as chemotherapy or radiation therapy, the surgeon becomes part of a multi-disciplinary treatment team. Therefore, the oncologic surgeon finds it necessary to become familiar with the principles of not only oncologic surgery, but also of chemotherapy, radiation therapy, tumor biology, and other aspects of cancer medicine.

Veterinary oncologic surgeons are also being asked to operate on animals with advanced malignant disease. It is no longer assumed that a patient with metastatic cancer is not a surgical candidate. Cytoreductive surgery, combined with other modalities, may make sense in certain patients with advanced disease. The objective in these cases is to get the neoplasm reduced to microscopic disease and allow other treatment, such as chemotherapy or radiation therapy, can control the remaining tumor cells. The more willing we are to take some aggressive surgical steps in animals with diffuse disease, the more we will learn about tumor behavior, life spans, etc. Although anecdotal, the author has had experiences with certain tumors that were excised even though the animal had diffuse metastatic disease and had the animal live a good-quality of life for several months up to a year.

One of the most important concepts for the oncologic surgeon is to not lose sight of the big picture. Before performing radical procedures, several basic questions should be asked: what is the extent of the disease, what other diseases are present, how feasible is resection and reconstruction, can the whole tumor be removed, and what are the owner's and the clinician expectations? These factors will be considered later in this handout. A thoughtful approach to the patient combined with a positive relationship with the owner increases the likelihood of a successful outcome.

Experience with oncologic surgery teaches the veterinarian many important lessons. One of the most important of these lessons is that the most success will be attained if one treats a "small tumor with a big operation." In other words, discover the malignancy early and treat it with a radical procedure. This gives the patient the best chance for a good outcome.

## Definitions

Incisional biopsy is the procurement of tissue from a lesion without removing it in its entirety. It is strictly a diagnostic procedure. Incisional biopsies are indicated to identify

the type of tumor present, helping the surgeon to plan the type of operation necessary. Some normal tissue should be included in the biopsy specimen in order for the histopathologist to better characterize the lesion. Incisional biopsy is ideal for peripheral lymph nodes that are draining a tumor to determine the stage of disease. Excisional biopsy also allows for procurement of tissue but involves removal of the entire tumor. Removal of a tumor by this method does not imply wide or radical excision, however.

Wide excision of a tumor means removal of sufficient normal tissue with the tumor so that there is an increased chance of removal of all macroscopic and microscopic tumor. The amount of normal tissue removed depends upon tumor type and location. In general, for most malignancies, at least 1 cm margin of normal tissue should be excised with the tumor to be considered a wide excision. However, for mast cell tumors, a 2-3 cm margin is recommended. This recommendation applies not only to the lateral and medial margin, but also to the deep margin. A common error is to disregard the deep margin and resect an inadequate amount of tissue. If 2-3 cm of deep tissue cannot realistically be removed, excision of the tissue layer below the tumor is usually adequate.

En bloc removal of a tumor is defined as removal of a tumor as a "whole". In other words, the tumor is excised with a section of all surrounding tissues being removed as well. For example, to remove a tumor in the subcutaneous space by en bloc excision the surgeon excises the overlying skin, surrounding subcutaneous tissues, and underlying muscle and fascia. The tissues are removed as a "block" of tissue with the tumor in the center.

Radical excision of a tumor is the most aggressive oncologic surgery performed. Radical excision involves extensive dissection and removal of tissues some distance from the primary tumor. For example, radical mastectomy is the removal of an entire chain of mammary glands along with lymph nodes, all underlying subcutaneous tissues and possibly some muscle, and regional lymph nodes, even if there was only one tumor in the chain. Another example of radical excision would be removal of a large section of thoracic or abdominal body wall in order to completely excise a tumor attached to the muscle.

### **Overview of Clinical Approach to Surgical Neoplastic Lesions**

Many factors should be considered before embarking on an oncologic surgical procedure. Define and stage the disease; is it benign or malignant, invasive or localized, and metastatic or confined to a single lesion? What organs systems are involved and can resection be safely performed? Is a radical surgical procedure feasible considering tumor location and tissue involvement? What other options are available for the disease and how does non-surgical treatment compare to surgical treatment in terms of results, complications, and cost. Will surgery be part of an integrated treatment plan including chemotherapy and/or radiation therapy? How will these adjunctive treatments affect tissue healing? What is the overall condition of the animal; is it a good risk for anesthesia and surgery? Obtain sufficient information from the patient to help gauge this risk, such as complete blood count, serum chemistry profile, urinalysis, thoracic radiographs, etc. Last but definitely not least, what are the expectations and attitude of the owner? How far is the owner willing to go, and are they realistic about the outcome? The veterinarian should not only inform the client about the disease and its treatment, they should develop a working relationship with the owner especially if extensive and costly treatments are planned. The owner needs to feel as comfortable and confident as

possible about the doctors and their plan and the veterinarian needs to feel that the owner supports the decisions that are being made.

### **Principles of Oncologic Surgery**

"*Early, wide, and deep*" is frequently quoted as one of the most important aspects of oncologic surgery. Detect the tumor early and treat it with an aggressive surgery. The first goal is to completely remove the tumor, the second goal is to close the wound. The surgeon must not compromise the margins of resected tissue because of anxiety over how to close the wound. Large skin wounds can be closed with rotating flaps or grafts or left open to heal by second intention. Large wounds of the oral cavity or nose can also be left open if necessary and the animal fed via a gastrostomy tube. Delayed closure can be then be performed if necessary. If the tumor is attached to bone, it is not helpful to scrape the tumor tissue off the bone; the bone must also be removed.

Tumors should be removed en bloc whenever possible. Handling of the tumor should be minimized, and invasion of its capsule avoided. The surrounding tissues should be frequently lavaged with sterile saline, and closure performed with clean gloves and instruments.

Resected tissues should always be biopsied, no matter how obvious the tumor appears to be. Give the histopathologist an adequate history, and orient the pathologist by marking tumors margins with sutures or India ink. Biopsies should also be obtained from surrounding tissues, lymph nodes, or other organs that could have metastatic lesions in order to stage the tumor.

If postoperative radiation or chemotherapy is anticipated, adjustments may be needed in the use of sutures or other implants in the wound. Non-absorbable sutures may be indicated if postoperative chemotherapy will impair wound healing, especially in dangerous situations such as with intestinal anastomosis.

### **Examples of Surgical Treatment of Specific Neoplasms**

#### **Mammary Neoplasia**

Considerable evolution has occurred in the surgical approach to mammary tumors. Many years ago, radical mastectomy (removal of all glands along with regional lymph nodes and underlying tissues) was recommended for virtually all mammary tumors of dogs and cats. Clinical studies have clearly shown that radical surgery is not necessary for most mammary tumors. (MacEwen, Withrow, 1989) Long-term survival is not enhanced by aggressive surgical removal of all glands compared to simple mastectomy (removal of one gland only) or lumpectomy. However, the principle of removal of sufficient tissue to achieve complete resection should not be compromised. Strategies for mastectomy are now dependent not so much on tumor type, but on location and extent of neoplasia, directions of lymphatic drainage, and how to achieve complete resection. Glands 1 and 2 drain cranially to the axillary lymph node, glands 4 and 5 drain caudally to the inguinal lymph node, and gland 3 can drain either cranially or caudally. Lymphatic drainage can occur to the other mammary chain and can also be altered by the neoplastic invasion.

Masses located between glands 4 and 5 are usually best removed by removing both glands 4 and 5 (regional mastectomy), especially if they are large. It is simply easier and less traumatic to the tissues to remove both glands than try to separate them. If gland 5 is removed, the inguinal lymph node is usually also removed and should be examined histologically. Masses on glands 1-3 can be removed by lumpectomy, simple

mastectomy, or regional mastectomy. The axillary lymph node is usually removed only if it is palpably enlarged or has cytologic evidence of neoplastic cells present in it.

Removal of all mammary glands is still recommended for those animals that have tumors in all glands, and some oncologists prefer to do radical mastectomies in cats due to the highly malignant nature of their mammary tumors. Bilateral simultaneous mastectomy has been described but the author prefers to stage the resection and do one side at a time.

Surgical complications consist of seroma, wound infection, dehiscence, and blood loss. These complications are minimized by adhering to sound principles of tissue handling, closure of dead space, and hemostasis. In mastectomy closure, the subcutaneous suture layer is of utmost importance to wound healing. The subcutaneous sutures are used to close dead space and relieve skin tension, allowing skin sutures to be placed loosely and decreasing the need for drains or postoperative bandages.

Like many other situations in oncologic surgery, knowing when not to recommend surgery is important to the animal with mammary neoplasia. Inflammatory mammary carcinoma, characterized by rapidly growing, invasive, and diffusely inflamed tumors, is not amenable to resection. These tumors cannot be completely resected and surgery can induce severe complications such as disseminated intravascular coagulation.

### **Oral Neoplasia**

Aggressive surgical resection of oral neoplasms has become the treatment of choice for most patients. Before reports of successful removal of oral tumors by mandibulectomy and maxillectomy, tumors were removed by scraping off bone, electrocautery, or just removing the soft tissue component. These conservative procedures were largely unsuccessful; rapid recurrence and/or metastasis usually occurred. Early and aggressive resection of oral tumors by mandibulectomy or maxillectomy can result in long periods of disease-free life or even cure in some cases. (Salisbury, 1988; Schwarz, 1991) Benign oral masses such as fibrous or ossifying epulis may require mandibulectomy or maxillary if bone is involved, and results are usually excellent. Of the common malignant oral tumors, the most encouraging results of surgery tend to be on the squamous cell carcinoma in dogs. The most common malignant oral tumor in cats is squamous cell carcinoma (SCC) but it is a more difficult tumor to manage than in dogs. SCC in cats grows rapidly and is very locally invasive. Oral malignant melanoma tends to rapidly metastasize, and fibrosarcoma tends to recur. However, even with these tumors, very early recognition and en bloc excision can be beneficial. One study suggested that tumors located rostrally in the mouth have a better prognosis than those located caudally. (Schwarz, 1991)

Surgical strategy for the patient with an oral tumor depends upon tumor type, location, and extent of tissue involvement. Preoperative radiographs or CT scan are imperative to determine if bone is involved and to what extent. Even if the bone appears normal on imaging and the tumor is thought to be malignant, en bloc excision of the tumor with the underlying bone is recommended. Extensive removal of bone and associated soft tissue can be performed without untoward effects on the animal. For example, for tumors located at mid-mandible or maxilla, complete unilateral hemimandibulectomy or maxillectomy can be done followed by standard soft tissue reconstruction. For tumors located at the rostral mandible, bilateral partial mandibulectomy can be performed back to and including the 2nd or 3rd premolar tooth. Extending the excision more caudally

than this can result in difficulty eating. The author has also performed bilateral maxillectomy in several dogs with an neoplasia of the hard palate. Multiple surgeries may be required to achieve soft tissue closure of the defects, but complete resection can be accomplished.

Cats are not quite as resilient as dogs in their response to extensive oral surgery. Hemimandibulectomy and hemimaxillectomy are performed and can be tolerated by cats, but more intensive nutritional support may be necessary. Percutaneous esophagostomy or gastrostomy tubes are frequently used to supply nutrition during the first several weeks postoperatively.

### **Cutaneous Neoplasia**

Tumors of the skin are some of the most common seen in veterinary practice. A wide variety of tumors occur, both benign and malignant. One of the most important principles of surgical management of these tumors is to establish a diagnosis before planning the operation. A very practical and accurate biopsy method of skin masses is fine needle aspirate (FNA). This information allows the clinician to plan an appropriate treatment. A benign skin tumor, such as an epidermal inclusion cyst, requires only a marginal excision and routine skin closure. Malignant skin tumors, such as mast cell tumor (MCT), require extensive tissue resection (e.g. 2-3 cm margin excision for MCT) followed by more complicated reconstruction.

It is very important to be sure that a complete resection has been performed before planning an extensive skin reconstruction or graft. If doubt exists concerning the skin margins, the wound may be left open and covered with appropriate dressings until the biopsy results are available. If histopathology reveals inadequate excision, the patient can be reoperated to remove more tissue, or other options such as radiation therapy can be considered.

Massive skin defects that result from extensive resection can be closed using a variety of reconstruction methods. Random or axial pattern skin flaps are used to close large skin wounds when appropriate tissues are available. Free skin grafts, such as mesh grafts, are used if local skin is not sufficient to close the wound. However, free skin grafts must be preceded by a period of open wound management to establish a bed of healthy granulation tissue. Our experience with mesh grafts has been very good in cats and fair in dogs.

### **Gastrointestinal Neoplasia**

The gastrointestinal tract is another system where surgery can offer definitive treatment for tumors. Benign tumors of the stomach, such as fibroma and leiomyoma, can be completely excised with surgery. Gastric leiomyoma is frequently found at the cardia of the stomach, making removal difficult. However, the tumor can be approached via a greater curvature gastrotomy and removed by submucosal resection within the stomach lumen. Even malignant tumors of the stomach, such as lymphosarcoma and adenocarcinoma, are sometimes resectable. We have operated several cats with early lymphoma of the stomach that were resectable and resulted in reasonable disease-free intervals. Adenocarcinoma of the stomach in dogs unfortunately is frequently located at the lesser curvature and may extend from cardia to pylorus. However, the author has seen some that were not so extensive and were removable by partial gastrectomy.

Resectability of intestinal tumors varies according to location and tumor type. Adenocarcinoma in dogs is frequently seen in the duodenum and colon. Duodenal

resection is complicated by its relationship to the pancreas and gall bladder, but tumors can be removed via resection and anastomosis especially if present in the distal duodenum and not involving the major duodenal papilla. Surgical removal of an intestinal tumor may be only palliative if metastasis has already occurred. However, significant prolongation of life can occur after removal of the primary tumor.

Intestinal tumors are amenable to wide resection since animals can function well after removal of a significant portion of the tract. Important surgical considerations are: maintain adequate blood supply to the bowel, be sure that the anastomosis is tension-free, use delayed absorbable suture (e.g. 4-0 PDS) for anastomosis, and be sure to biopsy other affected organs and tissues such as regional lymph nodes and liver.

### **Lung neoplasia**

Primary lung tumors are frequently amenable to surgical removal, especially if they are solitary and not adhered to surrounding structures. Although lung tumors are usually malignant (e.g. adenocarcinoma, squamous cell carcinoma), significant postoperative survival times are possible after complete resection. If the tumor is resected before metastasis has occurred, postoperative life span up to a year is possible. (Withrow, 1989) If the neoplasm has metastasized to mediastinal lymph nodes, postoperative survival is shorter.

There are some principles of lung tumor removal that should be considered. These tumors are frequently located near the hilus. The tumor may be adhered to the left or right atria, and/or the pericardium. Careful dissection is required to free the tumor from these important structures. In some cases, a section of pericardium is removed with the lung lobe to be sure that the entire tumor is removed. The surgeon should warn the anesthetist that some bronchial fluid may drain into the trachea during manipulation of the affected lung lobe. This can complicate ventilation by plugging the endotracheal tube. Periodic suction of the tube may be necessary during the procedure. Surgical stapling devices are very useful for partial or complete lung lobectomy. The device is used to close the bronchus or lung parenchyma by delivering 2 rows of "B" shaped stainless steel staples into the tissue.

After resection of the lung, check the bronchial stump for air leakage by flooding the site with warm saline and asking the anesthetist to give a positive-pressure inspiration. If leakage occurs, additional staples or sutures may be required. Also, check the remaining lung lobes and mediastinal lymph nodes for evidence of disease.

### **Principles of Postoperative Care**

The postoperative cancer patient has several needs that should be addressed. Firstly, postoperative analgesia should be provided, especially after extensive resection of tissue such as with mandibulectomy or maxillectomy. Fentanyl administered by CRI is our preference for immediate postoperative analgesia. Fluid support of the patient is also very important. Intravenous fluids should be administered until the animal appears to be able to maintain hydration with oral intake.

Nutritional support is also critical. Cancer patients tend to be in a poor plane of nutrition to begin with, and major surgery can delay return to an adequate level of food intake. If the surgeon anticipates a prolonged period of anorexia or inability to eat adequately, some kind of nutritional access device should be placed, such as a gastrostomy tube.

Long term follow-up is very important to monitor the patient for evidence of tumor recurrence or metastasis. The frequency of re-evaluations will depend upon the type of tumor. Maintaining good follow-up with the patient and owner also helps oncologists to collect data concerning disease-free intervals and long-term prognosis. Future trends in cancer treatment will be influenced by objective analysis of large patient populations and results of therapy.

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