Decision making in surgical oncology- when to cut big, when to cut small

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The majority of mistakes in surgical oncology are made as a result of proceeding with surgical excision without full knowledge of the tumour type and its biological behaviour, as well as the local and systemic extent of the tumour. This lecture will discuss how appropriate pre-operative planning will enable sound decision making to determine the extent of surgical margins required and to allow the application of an appropriate surgical dose.

Surgery remains the pivotal aspect of the treatment of tumours in small animals and a surgical cure should be the therapeutic goal in all cases if achievable. Of all treatment modalities, surgery cures more cancer than any other modality, by offering the best chance of a local cure. A curative surgery generally involves removal of the tumour with wide margins of normal tissue and adherence to the principles of surgical oncology. An approach to the surgical oncology patient is summarized in the flow diagram below:

Pre-operative evaluation
- Diagnosis, staging, patient status, surgical planning
- Pre-operative patient management/stabilization
- Biopsy principles
- Classification, planning intended surgical margins- surgical dose

Perioperative management
- Patient preparation
- Palliative surgery
- Cytoreductive surgery- multimodal/combination therapy
- Curative surgery, principles of oncologic surgery
- Wound closure and reconstruction

Postoperative management
- Postoperative patient monitoring
- Margin assessment
- Adjuvant therapy
- Reasons for surgical failure
Long term management
- Monitor for local recurrence, metastatic disease
- Adjuvant therapy

After death procedures
- Necropsy

Of these key steps, surgical planning and the pre-operative planning of the patient are pivotal to the surgical success. Therapeutic goals for each case should be established before a surgical approach is initiated.

KEY POINT: Failure to plan is planning to fail

A haphazard approach to an oncology case will often lead to failure. A surgical success is not strictly based on the successful healing and cosmetics of a surgical excision and wound closure, but by the impact of the surgery on the tumour itself and the survival time of the patient. Local recurrence of an excised tumour, that is unlikely to metastasize, is classified as a surgical failure and is usually caused by inadequate surgical planning and pre-operative planning. The ability to achieve a surgical cure is influenced by numerous factors including the biological behavior of the tumour, the location of the tumour and the feasibility of a clean excision. Knowledge of these factors prior to surgery facilitates a surgical plan and allocation of an appropriate surgical dose.

The decision for a curative intent surgery as opposed to palliative surgery (i.e. the therapeutic goal) is influenced by tumour grade and the results of staging. The balance between the morbidity of surgery and the expected outcome of surgery needs to be considered in each case. For example do you want to perform a hemipelvectomy for a grade III MCT that has splenic metastasis when surgery is not going to be curative and survival times are relatively short. The approach is also influenced by the availability of adjuvant therapies, which are constantly changing and hence a multimodal approach to the case with input from both the surgical and medical oncologist is imperative. In the case of a grade III MCT with splenic metastases requiring hemipelvectomy for local tumour control, should adjuvant therapy using targeted therapy enable long-term control of metastatic disease, the large surgical dose in this may be justified. With the constantly evolving immunotherapy techniques, surgical doses may also need to be adjusted according to improved survival times achieved with adjuvant therapy.

A summary of the key factors affecting the decision to perform a curative intent surgery are as follows:
- Tumor type => biopsy
- Size => measurement, palpation, imaging
- Location => palpation, imaging
- Morbidity of procedure required - e.g. wide local excision versus hemipelvectomy => imaging
- Tumour grade and risk of metastasis => biopsy
- Results of staging => imaging, additional tests
- Presence of comorbidities => will a patient cope with an aggressive curative intent surgery?
- Previous excisions => e.g. multiple mast cell tumour excisions of low grade - do we want to continue to perform wide local excisions each time?

KEY POINT: Based on the diagnosis, expected biologic behaviour of the tumour and the tumour grade, consideration of surrounding structures and the feasibility of excision, as well as owner and patient considerations, a “surgical dose” can be planned for the resection

The surgical dose can be an intracapsular resection (debulking in which a microscopic quantity of tumour remains), a marginal resection (just outside tumour's pseudocapsule, microscopic quantity of tumour remains), a wide resection (complete excision with all margins free of tumour cells) or a radical resection (remove entirety of a body part). A wide local resection is the most common “surgical dose” utilized in Veterinary medicine, with the width of margins of excision determined on the basis of tumour type, aggressiveness, anatomic location and the barrier provided by surrounding tissue. The anatomical margins are three dimensional - lateral, medial and deep. Consideration should also be given to the “quality” of the margin rather than just the “quantity”. This is most important when considering the deep margin. Collagen dense, vascular poor tissue such as cartilage, tendons, ligaments, fascia are resistant to neoplastic invasion whereas fat, subcutaneous tissue, muscle, and parenchymal tissue are not resistant. The aim of resection is to achieve a “cuff of normal tissue” surrounding the tumor and one additional tissue plane beyond that which the tumor touches. The surgical dose differs from a surgical margin in that a surgical dose is the amount of surgery required to achieve a specified surgical margin. A surgical margin denotes a tissue plane on the outside boundary of a resected (removed) specimen, the tissue beyond which is left in the patient.

Each particular tumour requires a unique surgical dose and without pre-operative knowledge of the factors outlined in the key point above, an accurate surgical dose cannot be formulated. For example, wide excision of a grade II soft tissue sarcoma that stages negative and requiring a hemipelvectomy for clean excision, can be justified with the knowledge of the tumour type, grade and the anatomical boundaries of the tumor based on imaging. This information allows an excisional plan with the aim of a surgical cure. The same surgical dose, however, may not be justified with a grade III soft tissue sarcoma in the same location with evidence of metastasis. In this case one may consider a less aggressive local resection (i.e. winding back the surgical dose) that will provide palliation and rely on other therapies to control the tumour without the expectation of a surgical cure. Not every case, therefore, do we aim for a big excision with the expectation of a surgical cure. Palliative surgery with less
aggressive resections does have a role in controlling cancer but does rely on a multimodal approach with adjuvant therapies. Wound closure should be pre-planned and a variety of wound closure techniques should be considered to avoid influencing the resection by concerns about the ability to close the deficit. The actual surgical approach chosen, needs to be made very clear to owners prior to surgery, to avoid any miscommunication in terms of expected outcome and surgical objectives.

In each case, therefore, we need to ask ourselves: Can a lump be excised with confidence, without the knowledge of the tumour type, its local extent, its risk of metastasis or the presence of metastasis. We also need to ask will adjuvant therapy be required? What information do we need to remove a lump with the intent to cure and is a curative excision feasible? The pre-operative evaluation needs to answer these questions and follows the following principles:

**Pre-operative evaluation- surgical planning**

The pre-operative evaluation includes a tumour diagnosis (cytology, biopsy), tumour staging- (local tumour disease, lymph nodes, metastasis), evaluation of patient status and patient stabilization and preplanning the margins of resection. The aim is to be able to answer the following questions:

- **What is it?** ⇒ FNA (especially round cell or discrete cell tumours), biopsy
- **Where is it?** ⇒ Tumour staging⇒ imaging etc- T, N, M scheme- define the boundaries of the mass and determine if there is evidence of metastatic disease
- **How bad is it?** ⇒ Grade
- **What is the status of the patient?** ⇒ Physical exam., blood work, urinalysis

An appropriate pre-operative evaluation will enable decision-making based on the neoplasm's biological behaviour, location and extent. Important diagnostic steps include radiographs/CT of the thorax, FNA of regional LN’s, and diagnostic tumour imaging including survey radiography, ultrasonography, CT, MR and scintigraphy. Pre-operative patient management and stabilization should include the identification of intercurrent disease, which may influence the treatment or adjuvant therapy, the control of paraneoplastic syndromes prior to surgery, evaluation of the nutritional status of the patient with the treatment of “cancer cachexia” and the evaluation of the patient’s coagulation status. Thrombocytopenia is a common finding in cancer patients, especially those with haemangiosarcoma, hemopoietic tumours and carcinomas. Localized intravascular coagulation, DIC and haemostatic derangements predisposing to haemorrhage are also relatively common.

**KEY POINT: More mistakes are made from not looking than not knowing**

The mainstay of pre-operative diagnosis is a biopsy. A biopsy is “to procure enough neoplastic tissue to establish an accurate diagnosis without jeopardizing local tumour control or the patient”. A biopsy permits a diagnosis and a treatment plan to be made and allows a prognosis to be given prior to definitive interventional treatment. Pre-surgical incisional biopsy is recommended unless the knowledge of the tumour type will not change the surgical procedure (e.g. solitary lung, splenic, intestinal masses) or when the risks of pre-operative surgical biopsy are higher than the definitive
surgical procedure (e.g. brain or spinal cord masses) or in the emergency situation (bleeding splenic mass).

**Principles of biopsy**

A number of very important principles should be followed when collecting a biopsy. These include choosing a biopsy site that can be later resected, a longitudinal rather than a transverse incision on the limbs, avoiding tumour seeding, avoiding areas of ulceration, necrosis or inflammation, orienting the biopsy in the direction of the definitive surgical resection, obtaining specimens from >1 region of the tumour, avoiding electrocautery, handling the specimen carefully to avoid tissue deformation, prompt and appropriate fixation (10 parts formalin:1 part tissue), a detailed history with the report, using a veterinary pathologist and providing multiple samples if possible. Biopsy methods include fine needle aspirate (FNA- good for round cell tumours), needle biopsy/punch (True-cut biopsy) performed blind or with imaging guidance (ultrasound, CT or MRI guided), incisional (wedge of tissue), excisional (complete removal), jamshidi, rongeurs, surface biting instruments with endoscope, and laparaoscopic or thoracoscopic assisted.

**Principles of surgical oncology**

In order to successfully implement a surgical plan, the following principles of surgical oncology are considered when curative intent surgery is the aim:

- Good knowledge of regional anatomy
- Pre-operative planning- should know *tumour type, grade, stage and expected behaviour*
- "Get it all the first time"
- Strict asepsis, sterile technique as immunosuppression
- Clip large area prior to surgery
- Gentle skin preparation to decrease exfoliation
- Complete exploration to determine extent of disease, tumour type, stage and expected behaviour
- Protect normal tissue from tumour cell contamination
- Isolate tumour with laparotomy sponges, use stay sutures
- Gentle handling, minimal tumour manipulation- stay sutures
- Do not open tumour during surgery
- Early ligation of major pedicles
- Wide margin in 3 dimensions- 1-3 cm depending on tumour type- dissect at least one normal tissue plane away from the tumour, tumours and adhesions removed en bloc- collagen-dense and vascular-poor tissues tend to behave as biologic barriers against cancer⇒ deep margin should include a fascial plane that has not been invaded by the tumor and is removed en bloc with the tumor
- Do not "shell out" malignant tumours
- Remove all biopsy tracts, any scars from previous resections should have the same margins as the primary mass
- Strict haemostasis
- Resection of regional lymph nodes if malignant
- Resect all affected tissue
- Wound closure or reconstruction with a separate set of instruments
- Position drains, grafts etc to minimise possible post op radiation fields
- Consider non-absorbable suture if delayed wound healing, as with chemotherapy
- Submit all resected tissue for histopathology- examine margins, mitotic index, vascular or lymphatic invasion, and the grade of the tumour
- Consider metal hemostatic clips to mark limits of the resection, especially if considering follow-up radiation therapy
- Do not compromise aggressiveness of surgery to allow easy wound closure-reconstructive techniques or secondary intention healing
- Consider submitting additional tissue from the remaining wound bed to assess for residual disease
- Radiographs of excised bone to assess the completeness of the excision