The utility of carbon dioxide laser in oncological surgery

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For The Education Center

Surgery has multiple roles to play in oncology, including prevention, diagnosis, palliation, and cure, either alone or as an adjunct to other oncological therapies. The carbon dioxide laser can be a handy surgical tool to perform these roles.

Hemostasis provided by laser incision helps maintain a clear surgical field, greatly enhancing the surgeon’s ability to observe surgical planes and obtain proper surgical margins around the tumor. Because of the bloodless field, laser excisions can be a bit more conservative than the conventional scalpel.

In other words, one can cut closer to the neoplasm without encroaching it.

Of course, sound oncological surgical principles of obtaining wide margins should not be compromised, but a bloody field often causes the surgeon to go wider and deeper than necessary to make sure the tumor is excised without seeing it, a notable goal of wide excision surgery.

When excisional biopsy is the goal, as opposed to wide excision, the laser again allows closer excision. Some laser artefact may be noted on histopathology, but the artefact does not interfere with diagnosis or examination of margin completeness, unless tumor cells abut the laser coagulated tissue, in which case one would question the comfort level of the excision anyway.

Many surgeons use electrosurgery for coagulation and incision during excisions of neoplasms. Electrosurgery remains desirable for coagulation because an active bleeder will not be coagulated by the laser. One can use the laser to tissue weld vessels and then cut them, but once the vessel is cut and bleeding, the carbon dioxide laser will be ineffective since it does not penetrate blood, accumulated tissue fluids, saline, etc.

Electroincision has been used in deep tissues for surgical excisions to minimize hemorrhage such as occurs when one cuts through muscle. However, the electrical stimulation causes rather dramatic muscular activity. A similar (even better – less jagged) bloodless incision of muscle can be achieved by using the laser with the additional advantage that the laser causes no muscle contraction. An occasional quiver may be noted when the laser hits muscle, but the muscle is essentially quiet.

One drawback to laser excision is length of surgery time. The limited depth of penetration of the carbon dioxide laser necessitates several passes to get through certain tissues such as skin. For that reason, it is common to make the skin incision with a standard scalpel, achieve hemostasis with electrosurgery, and then deepen the incision and dissect through subcutaneous and deep tissue planes with the laser.

The laser may be used with thin skin (cats), mucosal surfaces, and small skin mass excisions without significant increases in surgical time, and, in fact, surgery time may be shorter than conventional scalpel in these circumstances.

Following are six clinical case examples of using the carbon dioxide laser in oncological surgery.

CASE 1: A 5-year-old spayed Australian cattle dog diagnosed with lingual melanoma.

The tongue with melanoma on the tip is prepared for laser excision.

Apposition of dorsal and ventral tongue epithelium with simple continuous 5-0 poliglecaprone 25 submucosal suture (similar to an intradermal suture pattern).

Excision line marked on the tongue using a carbon dioxide laser (continuous wave, superpulse mode, 8 watts, 0.4 mm diameter tip).

Laser incision of the tongue prior to suturing.

Histopathology demonstrating the tumor (A), normal dermis (B), laser coagulated epidermis (C), and inked margin (arrow). [Diagnosis was apocrine duct adenoma, completely excised. Slides courtesy of Dr. Dae Young Kim, Veterinary Medical Diagnostic Laboratory, University of Missouri]

This Education Center article was underwritten by Aesculight of Woodinville, Wash., manufacturer of the only American-made CO2 laser.

Histopathology demonstrating the tumor (A), normal dermis (B), laser coagulated epidermis (C), and inked margin (arrow). [Diagnosis was apocrine duct adenoma, completely excised. Slides courtesy of Dr. Dae Young Kim, Veterinary Medical Diagnostic Laboratory, University of Missouri]

CASE 2: An 11-year-old spayed domestic short-haired cat presented for excisional biopsy.

A female cat presented for excisional biopsy of a 10 mm diameter mass ventral to the right eye.

Mass ventral to right eye prior to excisional biopsy.

Excisional biopsy of 10 mm mass using a carbon dioxide laser (continuous wave, superpulse mode, 6 watts, 0.4 mm diameter tip).

Excisional biopsy with margins marked with India ink.

Immediately postoperative appearance of laser surgical site ventral to right eye.

Histopathology demonstrating the tumor (A), normal dermis (B), laser coagulated epidermis (C), and inked margin (arrow). [Diagnosis was apocrine duct adenoma, completely excised. Slides courtesy of Dr. Dae Young Kim, Veterinary Medical Diagnostic Laboratory, University of Missouri]

Appearance of laser surgical site 19 days after surgery.
**CASE 3:** A 9-year-old neutered husky presented for partial maxillectomy.

*Recurrence sarcoma cranial to right upper canine tooth immediately prior to partial rostral right maxillectomy.***

*Outline of mucosal incision with a carbon dioxide laser (settings not recorded) prior to maxillectomy.***

*Laser coagulation (with defocussed beam) of the ulcerated portion of the oral lesion to help control tumor contamination of the incision.***

*Defect as result of partial rostral right maxillectomy.***

*Mucosal closure of partial rostral right maxillectomy.***

**CASE 4:** An 8-year-old spayed Labrador retriever presented for excision of a right perianal mastocytoma

*Right perianal 2x3 mm mass immediately prior to carbon dioxide laser incision.***

*Wide skin margins (equal to the diameter of the dermal mass) made by making a dotted line and connecting them with a carbon dioxide laser (continuous wave, superpulse mode, 8 watts, tip diameter not recorded).***

*Using a carbon dioxide laser to obtain deep margins of the dermal mass.***

*Wound after wide laser excision of the 2x3 mm dermal mass.***

*Closure of wound after wide laser excision of dermal mass.***

**CASE 5:** A 7-year-old spayed mixed breed dog presented for wide excision of suspected mastocytoma from lateral right pelvic limb.

*Wide skin margins (equal to the diameter of the dermal mass) made by making a dotted line and connecting them with a carbon dioxide laser (continuous wave, superpulse mode, 4 watts, 0.4 mm diameter tip).***

*Using a carbon dioxide laser to obtain deep margins of a dermal mass on the lateral right pelvic limb. (Note: The histopathologic diagnosis was intracutaneous cornifying epithelioma with complete excision.)***

**CASE 6:** An 8-year-old neutered domestic short-haired cat with vaccine-induced fibrosarcoma

*An 8-year-old neutered male domestic short hair cat with vaccine-induced fibrosarcoma over the right scapula presented for wide excision of the mass. (Dorsal is to the top of the photos and cranial is to the right.) Skin incision with 2 cm margin made around a mass over the right scapula using a carbon dioxide laser (settings not recorded).***

*Incising scapular musculature with a carbon dioxide laser to achieve at least one tissue layer deep to the mass.***

*Wound prior to closure after wide excision of the fibrosarcoma. The scapular spine and cranial half of the scapula were removed as part of the deep margin.***

*Closure of muscle fascia after wide laser excision of a fibrosarcoma which included partial right scapulectomy.***

*Skin closure after laser excision of a fibrosarcoma and partial right scapulectomy.***

*Deep surface of excised specimen, including cranial portion of right scapula, prior to application of India ink.***

*External view of specimen excised from the area of the right scapula using a carbon dioxide laser.***

*Wound after wide laser excision of a fibrosarcoma which included partial right scapulectomy.***

*Skin closure after laser excision of a fibrosarcoma and partial right scapulectomy.***

*Deep surface of excised specimen, including cranial portion of right scapula, prior to application of India ink.***

*External view of specimen excised from the area of the right scapula using a carbon dioxide laser.***