What are the applications for the laser in veterinary dermatology?

The focus in this lecture will be the use of the CO2 laser and my personal experiences and cases. The laser can be used for almost any procedure for which typical cold steel surgery is used. However where it comes in most useful is when a patient has multiple small lesions, lesions in highly vascular areas, or to remove proliferative tissues to promote healing.

The differences between the CO\textsuperscript{2} laser and diode surgical laser.

The CO\textsuperscript{2} laser has a long wavelength. Therefore it must be delivered by an articulated arm or a mirrored flexible hollow wave guide. This long wavelength is a great benefit in that the CO\textsuperscript{2} laser is an ablative laser and does NOT penetrate tissue deeply. Because this wavelength is absorbed by water the disadvantage to the CO\textsuperscript{2} laser compared to the diode is that it cannot be delivered through water.

The surgical diode lasers are typically in the wavelengths of 810 to 980nm. These wavelengths are absorbed by hemoglobin, oxyhemoglobin and melanin. The biggest draw back to the diode laser in the author's view is the deeper penetration into the tissue. This is especially concerning in the ear. The 980nm wavelength does absorb water better than 810nm so may be better for soft tissue surgery. The diode wavelength is not visible to the human eye and an aiming beam needs to be used. This makes visualization of fine dissection difficult. Diode lasers are less effective for skin incisions when compared to CO\textsuperscript{2} laser. The advantage to the diode laser is its size and cost compared to CO\textsuperscript{2} lasers. The other big advantage to the diode laser is its delivery system. The diode is delivered in a contact mode via flexible silica fibers. These fibers allow the laser beam delivery through fiber optic working channels such as used in video otoscopy. Also because of the contact mode and lesser absorption by water the beam can be delivered in water. Be cautious of heating. The current status of the CO\textsuperscript{2} laser tip availability does not allow use through a video otoscope at this time.

The CO\textsuperscript{2} laser has been very helpful in patients that have multiple epidermal lesions to be removed. Depending on size, these lesions once removed can heal by secondary intention as quickly as lesions closed with primary closure. Examples of more common lesions would include multiple sebaceous adenomas, hemangiomas, keratoacanthomas, and feline ceruminous cystomatosis.

There are multiple breeds in which multiple sebaceous adenomas can affect the quality of life due to pruritus and secondary infections. The removal of these lesions can significantly decrease the requirement for medical therapy. The time required to remove multiple small lesions with traditional surgery is more time consuming due to the need in most cases for primary closure. The laser provides a sterile eschar and allows healing by second intention for most smaller lesions.

Another example seen commonly with multiple lesions are white skinned sun bathing dogs that develop multiple hemangiomas. The recommendation is to remove the lesions that have become raised as a papule or nodule, but these dogs can have dozens of tiny macular lesions. With the laser it takes very little time to ablate these small macular lesions present at the time of surgery and prevent the need for future surgery for some time.

The laser is also very helpful in removing epidermal lesions difficult to close with primary closure, and in some cases laser is the only therapy with good success. Feline ceruminous cystomatosis is an example. This is an entity in which multiple fluid filled ceruminous cysts form initially on the tragal folds of the pinna.
If left untreated, the cysts extend down into the canal, occlude the canal, and secondary otitis externa and/or media develops. The cystic tissue is very thin and often adjacent to the pinnal cartilage. This makes removal of the entire cyst difficult with traditional surgery and without the removal of the entire cyst recurrence is likely. These lesions are then allowed to heal by second intention.

Depending upon the laser and the video otoscope unit, laser may be performed within the ear canal to vaporize masses or the base of the masses. This can be performed at the time of the biopsy of the tissue. Often it is not known at the time of the surgery if the mass being removed is simple proliferative glandular tissue versus an adenoma or other neoplasm. Ablating the base of the mass and area around it may prevent recurrence if the biopsy report reveals a neoplasm. Another example of a lesion best removed with laser is cutaneous angiomatosis. In veterinary patients, due to the progressive proliferative nature of this condition, previous recommendations included wide surgical excision or amputation. If the lesions occurred in a location where this was not possible (such as the face) the pets were euthanized. Laser therapy has been reported to be a successful alternative in these cases.1

Highly vascular areas are more easily handled using the laser. One of the more common procedures it has been recommended for is feline rhinectomy and/or pinnectomy secondary to squamous cell carcinoma (SCC). In the hands of an experienced laser surgeon, this procedure takes about 15 minutes, with more hemorrhage occurring from the sutures than the tissue removal. The size of the lesion is important with nasal SCC. The earlier these lesions are removed and the more aggressive the surgical margins will affect the recurrence rate of these cancers. The author prefers to remove the nasal tissue up to the junction of the nasal bone and cartilage dorsally. It is also better to remove a bit more of the upper lip filtrum than appears affected. Masses may be removed or biopsied from the nasal or oral cavity. Remember care must be taken when oxygen is being administered. A very problematic complication can be a tracheal tube fire. The laser can be used to remove neoplastic tissue on the penile sheath or perianal tissue with less pain and hemorrhage. Pinnectomy is a very quick procedure in the cat and only slightly more difficult in the dog. The laser beam can be used on low to draw the incision line. Remember the tissue is thin and the surgeon’s hands should be protected with moist gauze. After the first pinna is removed it can be used as a template for the second pinna so the patient is symmetrical post surgery.

Precision tissue removal can be performed with the single pulse mode on the laser. This is useful for actinic changes on the eyelid margin and distichiasis removal.

Infected tissue can be vaporized or removed using the laser. Surgical technique is very important so that the healthy tissue to remain is not contaminated with infected cells. The types of infections where this is important include papilloma virus, herpes dermatitis, mycobacterial granuloma and sarcoids. The utilization of the laser with proper surgical technique has resulted in decreased recurrence rates post therapy. Typically there is a “clean pack” and a “dirty pack”. The idea is that the laser vaporizes the incision, minimizes hemorrhage and lymphatic contamination and sterilizes the surgical margins. Any instruments that touches the infected tissue are set aside and the surgical site is closed with clean gloves and instrumentation. Lepromatous dermatitis is a nodular disease caused by a mycobacterial organism thought to be spread by biting insects. These dogs are usually short coated and present with growing nodules on the pinnae or nasal planum however lesions may become widespread. Medical therapy is available but long term medications with rifampin and clarithromycin in large breed dogs not only is very expensive but some patients cannot tolerate the therapy. Surgical removal of these lesions may be more cost efficient and successful but a controlled study needs to be performed. Another type of infected tissue includes chronic proliferative infected tissue. This is most commonly seen in cases of chronic otitis in certain breeds. If this problem is identified prior to calcification of the ear canal occurring, the duration of medical therapy may be shortened or total ear canal ablation may be avoided. Once the deep folded cauliflower like tissue is removed medical therapy is much more effective. The laser
has also been used to remove acral pruritic nodules with some success. Interdigital recurrent folliculitis and furunculosis may also be treated with laser therapy and allowed to heal by secondary or primary closure.

**CO\textsuperscript{2} Laser Guidelines**

The settings to use on the laser is a question received by all surgeons teaching this technique. The problem is the settings often depend on model of the CO\textsuperscript{2} laser that is being utilized, the surgeon’s ability and hand speed as well as the tissue being excised or ablated. The author has an older model CO\textsuperscript{2} laser that does not have the ability to super-pulse. Therefore my hand speed is adjusted in an attempt to minimize collateral thermal tissue damage. When performing surgery in an area where hemorrhage may be a problem using non-superpulse mode is beneficial to create a low level of thermal damage to coagulate the blood. Low level thermal damage can also seal lymphatics and sterilize the tissue from infectious agents.

When using a CO\textsuperscript{2} laser with 30 watts and super pulse availability the amount of peripheral tissue damage can be minimized and this is demonstrated with histopathology samples.

In general the following setting are a good starting point\textsuperscript{2}.

**Skin incisions**

- 0.4mm spot, 15-30 watts, continuous wave or non-superpulse
- 0.25 – 0.4 mm spot, 10-20 watts, continuous wave, superpulse

**Dissection**

- 0.4mm spot, 15-30 watts, continuous wave or non-superpulse
- 0.25 – 0.4 mm spot, 10-20 watts, continuous wave, superpulse

**Ablation**

- 0.8 – 1.4 mm spot or ablation nozzle, 12 watts is not very good for 1.4mm spot,
  
  For larger ablations the 30 watt laser is best to minimize peripheral tissue damage.

**Diode Laser Guidelines**

The diode laser is delivered to the tissue via the flexible fiber. These fibers are available in 200 – 1000 microns. They cannot be autoclaved with steam but may be sterilized with gas or plasma sterilization. The tip of the fiber must be prepared. This is called cleaving the fiber. The fiber is typically activated in contact against a tongue depressor with a black mark. The tip is then cut with a special cutting instrument. This char on the tip of the fiber is important to enhance delivery of thermal energy.

The diode laser can be used in contact delivery (touching the tissue) or non-contact. Do not fire the laser while in the working channel of the video otoscope device\textsuperscript{2}.

**Skin incisions**
For skin incisions contact mode must be used. Typically a 600 micron or less fiber is used with a setting of 3-9 watts. The fiber end must be activated. Pulsed setting help to reduce thermal injury to the epidermis. Hand strokes or brush strokes followed by irrigation also help reduce thermal injury.

Dissection

A 400 – 600 micron fiber is used for dissection at 3-7 watts. Similar technique with brush strokes and irrigation are recommended.

Non-contact delivery

This is only used in heavily pigmented or vascular tissue at high power levels. Power levels of 10 Watts or greater and collateral damage to the tissue of 3mm can result.

Summary

In short the laser is a tool now available in veterinary medicine that allows us to provide state-of-the-art patient care. It allows procedures to be performed that could not otherwise be accomplished. It also provides a sterile, dry surgical field and improved healing, while also decreasing post surgical pain. If not used properly the patient and staff may be injured with the laser so training and experience are very important.

References