

Surgical treatment using CO₂ laser of feline squamous cell carcinoma of nasal planum in 6 cats

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Abstract

The objective of this study was to report the outcomes of surgical excision of feline squamous cell carcinoma (SCC)-affected nasal planum by using CO₂ laser. Six cats histologically confirmed with SCC accounted for T2 (33.33%), T3 (33.33%), and T4 (33.33%) were included in this study. CO₂ laser was used to excise SCC lesion and clinical outcomes were followed up. The CO₂ laser minimised blood loss during surgery and the mild inflammation of surgical wound was controlled after surgery. All cats that underwent surgical excision using CO₂ laser showed complete wound healing in a median of time at 27 days after surgery. Tumor recurrence and disease free interval (DFI) were recorded and statistically analyzed. The overall median time of recurrence was 150 days after surgery and there was a significant correlation between the stage of tumor and local recurrence. Lesions in the early stage of SCC showed longer DFI than those in the advanced stage. Therefore, the use of CO₂ laser could be considered as an alternative way of surgery for early stage of feline nasal planum SCC.

Keywords: carbon dioxide laser, cats, nasal planum, squamous cell carcinoma

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Introduction

Squamous cell carcinoma (SCC) is a malignant skin tumor arising from squamous epithelium. Although a vast majority of feline SCCs affects the oral cavity, cutaneous SCC accounts for 15% of all feline skin tumor (Miller et al., 1991; Layne and Graham, 2016). Cutaneous SCC frequently occurs at non-pigmented skin with relatively little hair coverage such as ear pinnae, eyelid, temporal areas, and nasal planum (Dorn and Priester, 1976; Lana et al., 1997). Cumulative exposure to ultraviolet (UV) light is considered to be a possible aetiology of this disease (Dorn et al., 1971; Ruslander et al., 1997). The treatment of feline SCC depends on the stage of tumor, which is classified by the World Health Organisation staging system of feline tumors of epidermal origin (Owen, 1980) (Table 1). Cutaneous SCC can be treated with surgery (Withrow and Straw, 1990) while intratumoral chemotherapy (Theon et al., 1996), radiotherapy (Theon et al., 1995; Fidel et al., 2001; Kinzel et al., 2003), and photodynamic therapy (Bexfield et al., 2008) were also reported as available options of treatment.

Carbon dioxide (CO₂) laser is a gas laser that emits an infrared light at a wavelength of 10,600 nm (Kaplan, 2010). This high power gas laser creates coagulation, ablation, and cutting effect on soft tissue as it is highly absorbed by tissue with high water content before transforming into heat to create cell rupture from boiling (Omi and Numano, 2014). The advantages of CO₂ laser include the control of bleeding, edema, and the possibility of less postoperative pain (Ize-Iyamu et al., 2013). However, CO₂ laser can cause a delay of wound healing from tissue necrosis (Paczuska et al., 2014). Thus, CO₂ laser

is considered as an alternative technique of surgery, especially oral and maxillofacial surgery (Pecaro and Garehime, 1983).

The aim of this study was to report the effectiveness and safety of surgical treatment using CO₂ laser in six cats with cutaneous SCC-affected nasal planum.

Materials and Methods

Animals: Six cats with SCC lesions at the nasal planum presented and referred to the Small Animal Teaching Hospital, Faculty of Veterinary Science, Chulalongkorn University were included in this retrospective study. All cats were domestic short hair with the median age of 11.66 years (range of 7-17 years). All cats underwent routine complete blood count and biochemical evaluation. The results obtained showed that two cats were healthy, but four cats had mild elevation of blood urea nitrogen (BUN) and creatinine (range of 37-43 and 2.3-2.4, respectively). Thoracic and abdominal radiographs and fine needle aspiration (FNA) were performed in all cats and showed no metastasis to the lung and regional lymph nodes. The diagnosis of SCC in all cats was based on cytology from the fine needle aspiration and histological evaluation from biopsy. The tumors were then graded according to the World Health Organization system for classification of feline tumors of epidermal origin (Table 1). Two cats were confirmed as T2 stage, defined as a minimal invasion of SCC lesion, while the rest were confirmed as T3 and T4, defined as an invasive lesion that invades subcutis or muscle and bone (Table 2).

Table 1 World Health Organization classification for feline tumors of epidermal origin, modification by Owen

Stage	Feature
T0	No evidence of tumor
Tis	Tumor in situ
T1	Tumor diameter < 2 cm
T2	Tumor diameter 2-5 cm or minimally invasive
T3	Tumor diameter >5 cm or invasion to subcutis
T4	Variable diameter, tumor invading fascia, muscle, or bone
N0	Absence of Lymph node metastasis
N1	Presence of Lymph node metastasis
M0	Absence of distant metastasis
M1	Presence of distant metastasis

CO₂ laser: The excision of tumor by CO₂ laser (Smart pulse®) was allowed by the cats' owners who preferred only surgical treatment. Acepromazine (0.03 mg/kg, intramuscularly) was used as a premedication to lightly sedate the cats before anesthesia. Induction and maintenance for general anesthesia were done using propofol (4 mg/kg, intravenously) and isoflurane 1-2% diluted in oxygen, respectively. All cats received infraorbital nerve block with lidocaine (2 mg/kg) and morphine (0.1 mg/kg). The surgical excision using CO₂ laser was performed after positioning the cats in sternal recumbency. Plastic protective glasses were used in all cats under general anesthesia. The endotracheal tubes were protected with sterile abdominal swab soaked with sterile normal saline. The area was prepared with chlorhexidine, betadine, and alcohol. A circular drape

was placed over the nasal region and clamped with towel forceps gently. Excision was performed using 4.5 W power output in continuous wave (CW) mode with 0.2 mm spot diameter (SD) and power density of 5.73 W/cm². The CO₂ laser was set to create cutting effect around the lesion without burning the surrounding tissue. The probe was positioned perpendicularly to the lesion and tumors were excised together with 0.5-1 cm surrounding normal tissue. The surgical wounds were then minimised in size by long-term monofilament absorbable suture with purse string suture pattern. The nostrils were spared and dilated with simple interrupt pattern and nasal tube placement was secured. The specimens were then collected for histologic evaluation. After operation, the cats were hospitalized to observe any adverse effect until clinically stable. Meloxicam and amoxicillin with

clavulanic acid were given to the cats to control inflammation and infection.

Table 2 Information about the 6 cats with lesions of SCCs treated with CO₂ laser

Cat	Gender	Coat	Age	Tumor site	Staging	DFI (days)	Follow-up	Biopsy result
1	Female/ intact	White	11	Nasal planum	T2N0M0	355 141	Still in CR	Poorly differentiated SCC
2	Female/ intact	Beige	17	Nasal planum and upper lip	T4N0M0	90 89	Lived with tumor	Poorly differentiated SCC with suppurative dermatitis
3	Male /intact	Tri colour	7	Nasal planum and upper lip	T3N0M0	165	Lived with tumor	Poorly differentiated SCC with suppurative dermatitis
4	Male /intact	Beige	15	Nasal planum	T2N0M0	180	Still in CR	Poorly differentiated SCC
5	Female/ intact	Tri colour	10	Nasal planum and upper lip	T3N0M0	152	Lived with tumor	Poorly differentiated SCC with suppurative dermatitis
6	Female/ intact	Tri colour	10	Nasal planum and upper lip	T4N0M0	281	Lived with tumor	Poorly differentiated SCC with suppurative dermatitis

N=Neutered

CR=Complete Remission

Tumor response: Four cats were scheduled to revisit the oncology unit every month for routine reassessment for recurrence and metastasis. The other two cats were subsequently referred to a veterinarian at local veterinary hospitals for reassessment. In terms of assessment, physical examination, blood collection and thoracic radiograph were performed every month, while local recurrence was carefully observed everyday by the cat owners. Disease free interval (DFI) was recorded base on the censor date of 29th January 2018.

Statistical analyses: Statistical software package was used to obtain statistical analyses. The Kaplan-Meier method was performed to generate DFI plots and median time to recurrence was reported with 95% confidence interval (CI). Significance between TNM stages was reported using the log-rank (Mantel-Cox) test.

Results and Discussion

From history taking, all cats were exposed to sunlight frequently. All cats had lesion at the nasal planum. Furthermore, lesions at the upper lip were also noted in four cats. All lesions were erythematous and ulcerative, but different in size. Most of the advanced lesions were infected, especially T4 lesions. Regarding WHO classification, two lesions were in stage T2, two in stage T3, and two in stage T4. None of the cats had regional lymph node involvement and metastasis at the initial presentation. Mild azotemia from chronic kidney disease was found in four cats as a concomitant disease. Peri- and postoperative, none of the cats had anesthetic complications. After operation, mild surgical wound inflammation was found at median time of 2 days (range of 1-3 days), however, mild serous nasal discharge was observed at median time of 12.66 days after surgery (range of 0-28 days). The surgical wounds were completely healed at median time of 27.63 days after surgery (range of 21-39

days). One of the T2 lesion had a DFI of 355 days and local recurrence occurred. The local recurrent lesion was surgically excised by CO₂ laser and in a complete remission for 141 days (Fig. 1). The other T2 lesions were in complete remission with DFI of 180 days. All T3 and T4 lesions recurred. The T3 lesions recurred on days 152 and 165 after surgery. One of the T4 lesions recurred on day 281 after surgery and the owner refused to repeat the surgery. The other T4 lesion manifested recurrence on day 90 after the first surgery and was offered for repeat surgical excision with CO₂ laser. However, the second recurrence occurred on day 89 after the second surgery and the owner refused to repeat the surgical excision.

According to the DFI analysis (Fig. 2), the graph showing complete response recurred with a median time to recurrence of 150 days (95% CI, 89-355 days). The log-rank (Mantel-Cox) test showed significant difference in the recurrence rate of surgical excision using CO₂ laser between the early stage (T2) and late stage (T3-T4) groups (P value = 0.049). Therefore, the stage of feline nasal planum is related to SCC recurrence.

In this report, the cats had totally or partially white coat, thus supporting the etiology of this disease that cats with non-pigmented skin that are exposed to sunlight have a tendency to develop this disease (Dorn et al., 1971; Murphy, 2013). The median age of all the cats affected by this disease is in accord with that reported in other studies (Bexfield et al., 2008; Cunha et al., 2010), which therefore confirms that SCC is likely to develop in old cats.

Several treatments have been reported including chemotherapy (Theon et al., 1996), radiotherapy (Theon et al., 1995; Fidel et al., 2001; Kinzel et al., 2003; Cunha et al., 2010), and photodynamic therapy (Bexfield et al., 2008). Among these, surgical excision SCC is considered as the most effective way to treat cutaneous SCC (Lana et al., 1997; Thomson, 2007). A complete resection of nasal planum or nosectomy using conventional scalpel blade was

described (Withrow and Straw, 1990) and so was its modified technique (Thomson, 2007). Cryosurgery of feline nasal planum SCC was also reported as an

alternative choice, but success could be achieved only at early stage of SCC (Budiak et al., 1991; Prado et al., 2017).

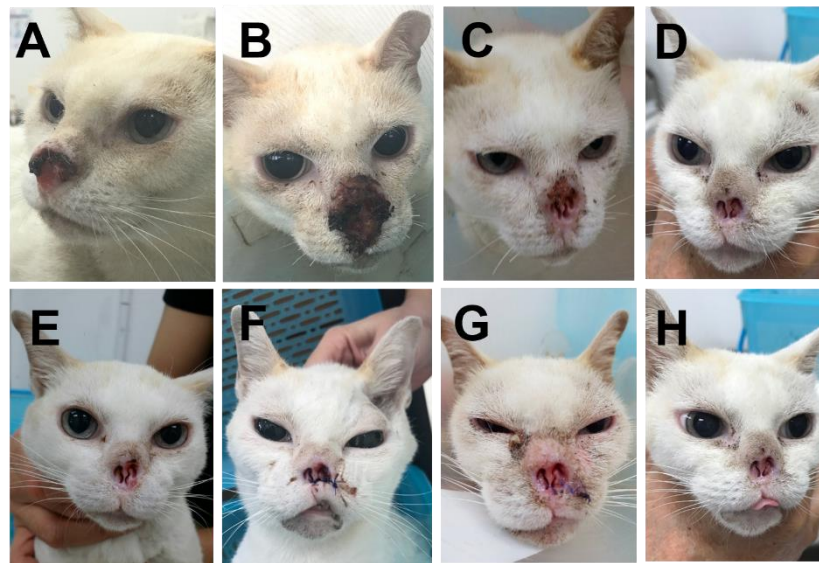


Figure 1 The surgical excision of squamous cell carcinoma at nasal planum in cats using CO₂ laser. Photographs of lesion (cat 1) before (A), 10 days (B), 25 days (C), and 276 days (D) after first surgical excision using CO₂ laser. Recurrent lesion appears at 355 days after first surgery (E). The second surgical excision using CO₂ laser was done and the photographs of days 10 (F), 25 (G), and 81 (H) after surgery are shown.

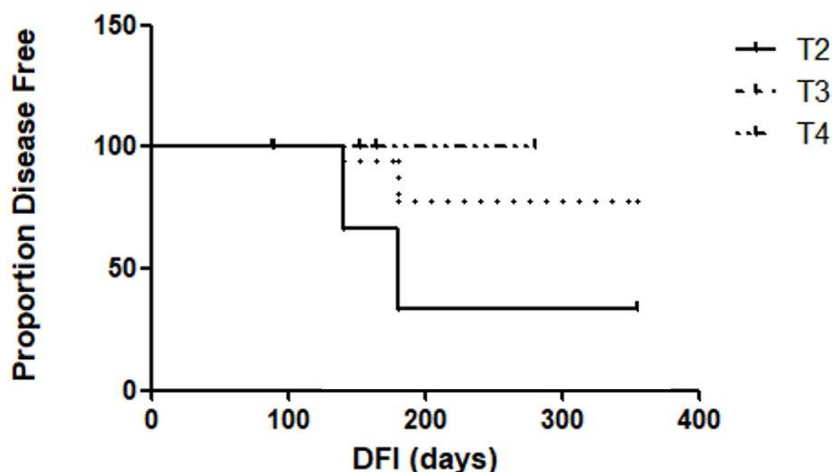


Figure 2 Kaplan-Meier plot for Disease Free Interval (DFI) of 6 cats with squamous cell carcinoma at nasal planum in different stages (T2-T4) treated with surgical excision using CO₂ laser

From literature reviews, the use of CO₂ laser for surgical excision in veterinary medicine has been described in few reports (Bartels, 2002; Paczuska et al., 2014). Compared to conventional scalpel blade, the use of CO₂ laser minimises blood loss from coagulation effect as it can seal small blood vessels, lymphatics, and nerve endings (Hernandez-Divers et al., 2008). Moreover, there is a report that CO₂ laser can reduce intraoperative contamination of tumor cell (Holt and Mann, 2002). Therefore, these effects can prolong DFI of cats having cutaneous SCC removed by CO₂ laser. Nares stenosis is a complication in conventional surgical excision techniques, thus in the present study the nasal tubes were placed for 3 days after operation and no stenosis of the nares was found in any cases. Also, the inflammation was controlled in all cases with

no infection. However, the most common complication found in this study was serous nasal discharge. Every cat had a serous nasal discharge at an average of 12.66 days after surgery. This might result from thermal damage of the surrounding tissue which can cause reversible inflammation and trauma of surrounding soft tissue (Hendrick and Meyers, 1995). This relates to other studies reporting that tissue oedema occurred in most cases after surgery (Paczuska et al., 2014). In the same way, wound dehiscence was found in two cases in this study on days 5 and 11 after surgery. The wounds were then cleaned daily with sterile normal saline solution and left to be healed by secondary intention. This might also result from thermal damage causing abnormal wound healing and thus increasing the risk of wound dehiscence.

When compared to the conventional surgical excision technique, the present study found that CO₂ showed less complications and resulted in satisfied DFI in the early stage of tumor. This correlates with other reports that showed fewer recurrence by using CO₂ laser compared to conventional blade excision from the ligation effect of small blood vessel and lymphatics stops tumor cell spreading (Lanzafame et al., 1988). However, the advanced lesions such as T3 and T4 recurred. This is due to the fact that advanced lesions invasively involve muscle and turbinate bone and could not achieve clear margin from surgical excision. Thus, it is suggested that surgical excision of CO₂ could be an alternative technique for the treatment of feline nasal planum SCC at early stage, while multimodal treatment with other techniques such as radiotherapy should be used for the treatment of advanced lesion with the objective to improve DFI in the future.

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บทคัดย่อ

การผ่าตัดมะเร็งเซลล์สความัสที่บริเวณผิวหนังเรียบปลายจมูกในแมวจำนวน 6 ตัว ด้วยคาร์บอนไดออกไซด์ เลเซอร์

พรรณระวี ภูมิวุฒิสาร^{1*} เกียรติพิเชษฐ์ โคมิน¹ ภัทรกฤษ อีวสุตระกูล² เกียรติ แวงศ์นุกุล¹

การศึกษานี้มีจุดประสงค์เพื่อรายงานผลของการผ่าตัดมะเร็งเซลล์สความัสที่บริเวณผิวหนังเรียบปลายจมูกแมวในระยะต่าง ๆ (ระยะ T2 ถึง T4) ในแมวจำนวน 6 ตัวโดยวิธีการผ่าตัดด้วยคาร์บอนไดออกไซด์ เลเซอร์ จากการติดตามผลการรักษาพบว่า การผ่าตัดด้วยคาร์บอนไดออกไซด์ เลเซอร์สามารถห้ามเลือดระหว่างการผ่าตัดได้เป็นอย่างดี และพบการอักเสบบริเวณแผลผ่าตัดเพียงเล็กน้อยเท่านั้น แผลผ่าตัดหายอย่างสมบูรณ์ภายในระยะเวลาเฉลี่ยประมาณ 27 วันหลังผ่าตัด จากการศึกษาและวิเคราะห์ทางสถิติพบว่า การเกิดซ้ำของมะเร็งสามารถพบได้ที่ค่าเฉลี่ย 150 วันหลังการผ่าตัดและระยะของมะเร็งมีผลต่ออัตราการเกิดซ้ำของมะเร็งหลังจากการผ่าตัดอย่างมีนัยสำคัญ โดยพบว่า มะเร็งระยะเริ่มต้นมีอัตราการเกิดซ้ำที่ต่ำกว่ามะเร็งระยะปลายที่มีความรุนแรง จากการศึกษาในครั้งนี้สามารถสรุปได้ว่า คาร์บอนไดออกไซด์ เลเซอร์สามารถใช้ในการผ่าตัดมะเร็งเซลล์สความัสที่บริเวณผิวหนังเรียบปลายจมูกแมวในระยะเริ่มต้นได้ ซึ่งเป็นอีกทางเลือกหนึ่งในการรักษาที่ได้ผลดี

คำสำคัญ: คาร์บอนไดออกไซด์ เลเซอร์ แมว ผิวเรียบปลายจมูก มะเร็งเซลล์สความัส

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