CT-Guided Thermoablation of an Oral Tumor in a Local Dog

—— Radiofrequency ablation of an oral tumor in a local dog through tumor boundary temperature control

Introduction

Oral tumors in dogs are relatively common diseases, seriously affecting dogs' health and quality of life. In terms of incidence, oral cancer accounts for about 5%-6% of canine cancers.

In terms of tumor types, malignant melanoma, squamous cell carcinoma, and fibrosarcoma are the most common. Malignant melanoma mostly occurs in the gingiva, buccal mucosa, or lip mucosa, commonly seen in middle-aged and elderly dogs, especially those with pigmented oral mucosa; squamous cell carcinoma has strong local invasiveness, although its metastasis rate is relatively low, it can appear in multiple parts of the oral cavity; fibrosarcoma mainly grows in the oral soft tissues, with strong local aggressiveness. In addition, there are some rare types such as odontogenic ameloblastoma.

At present, the main treatment for canine oral tumors is surgical excision, but for elderly dogs or dogs with other serious diseases, the risk of excision surgery is high and not conducive to postoperative recovery.

Tumor radiofrequency ablation (RFA), as an important minimally invasive treatment method, has occupied an increasingly key position in the field of tumor treatment in recent years. When the ablation needle releases radiofrequency current, the ions in the tumor tissue oscillate and rub at high speed, generating local high temperatures of 60–100°C in a short time, causing protein denaturation, cell membrane rupture, and then coagulative necrosis, achieving the goal of in situ tumor inactivation.

When performing RFA for tumor treatment, if the ablation boundary cannot be controlled, it will cause damage to healthy tissues and organs around the tumor, especially since the dog' s oral cavity and surrounding area are densely distributed with nerves, such as the trigeminal nerve, maxillary nerve, mandibular nerve, palatine nerve, lingual nerve, etc. If the ablation boundary is not controlled, it is easy to damage the nerves.

This study explores the feasibility of using a tumor RFA system with controllable ablation boundaries for canine oral tumors.

Case Proper

Case introduction:

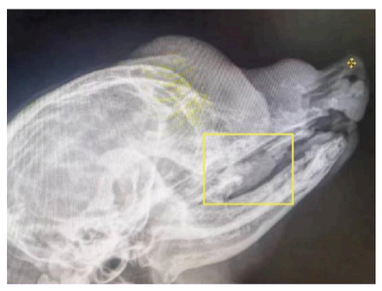
11-year-old male dog, local mixed breed, with heart disease and lung disease, visited due to oral tumor bulging and inability to eat independently. External examination found a cluster of multiple tumors on the right side of the upper jaw, with four individual tumors forming a chain, the largest tumor diameter was 2.7 cm, the smallest was 1.5 cm, and it caused compression to the nasal cavity and eyes.



- Photos of the dog' s oral tumor



- Photos of the dog' s eye compression



- CT images of the dog' s tumor

Surgical plan analysis:

Due to the dog' s old age and heart and lung disease, open surgical excision was not suitable. After comprehensive assessment by the doctor, minimally invasive treatment using a tumor RFA system was adopted.

Thermoablation operation procedure:

- The dog was under general anesthesia. An ablation needle suitable for a 3 cm tumor was selected to puncture the 2.7 cm tumor, and the temperature probe was placed on the surface of the tumor; smart ablation was initiated, and the tumor boundary temperature was fed back to the console by the temperature probe. The console automatically adjusted the power based on the temperature rise rate and tumor impedance changes. When the temperature probe detected that the tumor boundary temperature reached 45°C, the power was reduced, maintained for 2 minutes, and the console automatically ended the ablation of this tumor.
- An ablation needle suitable for a 3 cm tumor was selected to puncture the 2.4 cm tumor, repeating the above steps;
- An ablation needle suitable for a 2 cm tumor was selected to puncture the 1.8 cm tumor, repeating the above steps;
- An ablation needle suitable for a 2 cm tumor was selected to puncture the 1.5 cm tumor, repeating the above steps.
- After the above four ablations were completed, the oral tumors were all treated with RFA, and the surgery ended.

Surgical Process and Clinical Results

During RFA surgery



(First ablation site photo)



(Second ablation site photo)

First tumor ablation (diameter 2.7 cm): ablated in smart mode, total time 8 min;

Second tumor ablation (diameter 2.4 cm): ablated in smart mode, total time 8 min;

Third tumor ablation (diameter 1.8 cm): ablated in smart mode, total time 5 min;

Fourth tumor ablation (diameter 1.5 cm): ablated in smart mode, total time 4 min;

After the four ablations, no ulceration or burn-through occurred on the tumor surface, no carbonization or adhesion occurred between the RFA needle and the tumor, and the needle was withdrawn smoothly;

Post-RFA surgery:

- Day 2: small amount of liquefaction in the necrotic area of the tumor, with spontaneous outflow of tissue fluid;
- Day 3–5: large amount of liquefaction in the necrotic area, with spontaneous outflow of tissue fluid;



- Day 7: the necrotic area of the tumor was completely liquefied, with spontaneous outflow of tissue fluid;
- Day 14: the tumor completely disappeared, and the tumor area healed;
- Six months follow-up showed no tumor recurrence, and the dog' s health status was good.



Discussion about Thermoablation

Compared with traditional surgery, RFA does not require incisions, only needs to be punctured with an ablation needle of 2.2 mm diameter, the postoperative wound only needs compression hemostasis, and the patient can be discharged after postoperative observation, greatly shortening the recovery period, especially suitable for elderly, weak, or animals with underlying diseases.

This tumor RFA system collects the tumor boundary temperature in real time through the temperature probe, realizing controllable ablation of the tumor area and greatly reducing damage to the surrounding healthy tissues and organs.

The tumor RFA system automatically adjusts the output power through dual-variable control of temperature and impedance, reducing the dependence on physician experience and greatly improving surgical efficiency and convenience.

Advantages: minimally invasive, convenient, high precision, short operation time.

This case indicates that thermal ablation has potential in canine oral tumors and is worthy of further research and promotion.

Conclusion from this Case

It shows that by using feedback control algorithms and temperature and impedance signal acquisition technology, the RFA system can achieve precise ablation and control of the tumor boundary, greatly reducing thermal damage and over-ablation to surrounding healthy tissues and organs.

In this case, the RFA treatment was minimally invasive, convenient, and efficient, with no recurrence observed at 6-month follow-up. It may be considered as an option for cases not suitable for surgical excision or with poor response to radiotherapy and chemotherapy. Individual results may vary.

