

## Feline Vaccine-Associated Sarcomas

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Feline vaccine-associated sarcomas have presented many challenges. Initially, the etiopathogenesis and biological behavior of these tumors had to be characterized, and strategies implemented to move tumors away from problematic sites. Next, diagnostic and treatment recommendations evolved as the biologic behavior of vaccine-associated sarcomas forced early and aggressive intervention. Current therapeutic strategies are expensive, at times debilitating, and frequently fail to effect tumor control. This review summarizes the known history, epidemiology, etiology, and clinical management of vaccine-associated sarcomas after a decade of work. The next challenges must be to find more practical and effective solutions, and to eliminate the cause of vaccine-associated sarcomas.

**Key words:** Chemotherapy; Computed tomography; Radiation therapy.

The emergence and characterization of vaccine-associated sarcomas in cats has had a profound effect on veterinary medicine. An unexpected consequence of this phenomenon is the evolution of cancer management recommendations for vaccine-associated sarcomas that now represent a new paradigm for cancer management regardless of species or tumor type. The most important lesson learned from cats with vaccine-associated sarcomas is the requirement for aggressive management early in the course of disease. Although this seems obvious now, it embodies several dramatic shifts in behavior by the veterinary profession. Before experience with these tumors, excisional biopsies and close marginal resections were performed routinely. In many situations, excisional biopsies were conducted casually and were often the only therapeutic maneuver. The potential harm of inappropriate and incomplete treatment of vaccine-associated sarcomas is now recognized. Preoperative, incisional biopsies for treatment planning have replaced excisional biopsies and cats with vaccine-associated sarcomas are now referred to specialists capable of aggressive, often multimodality, treatment. In addition, the value of sophisticated diagnostic imaging for treatment planning and the importance of adequate marking of the resected specimen for evaluation of margins is established. These lessons are not new to our profession but we had not previously been challenged to confront such a uniformly aggressive tumor. These experiences led to rapid, widespread acceptance of more thorough staging and more thoughtful treatment recommendations for vaccine-associated sarcomas.

The urgency of developing an adequate cancer control policy was never more compelling than with vaccine-associated sarcomas. The lessons could not have been learned so quickly without a community galvanized by the frustration of this dilemma. The effort to overcome vaccine-as-

sociated sarcomas in cats has involved diverse groups, large funds, and countless hours. As a result of this effort, cancer awareness and management in veterinary medicine has moved forward collectively such that the ultimate legacy of this terrible consequence may be better cancer control for both dogs and cats.

### Background Information

The prevalence of feline rabies was noted to increase in 1979. This was attributed to the small number of vaccinated cats and an outbreak of wildlife rabies in the United States. Additionally, postexposure prophylaxis in humans after exposure to cats with suspected rabies was increasing. In 1987 the state of Pennsylvania enacted a law requiring rabies vaccination of cats.<sup>1</sup> Such public health concern and approval for subcutaneous administration of rabies vaccines in the mid-1980s resulted in increased subcutaneous administration of rabies vaccines in cats in the United States. In 1985, a subcutaneously administered killed aluminum-adsorbed rabies vaccine was approved for use in cats and largely replaced the use of the intramuscularly administered high-egg passage modified-live virus rabies vaccine.<sup>2</sup> In 1985, a killed aluminum-adsorbed feline leukemia virus (FeLV) vaccine was also introduced.<sup>2</sup> Both of these vaccines were widely used by veterinarians to vaccinate cats subcutaneously against rabies and FeLV.

The 1st description of a local reaction to rabies vaccination published in 1986 described 13 dogs that developed a focal cutaneous vasculitis and alopecia at sites of inoculation.<sup>3</sup> In 1988, 9 cats were reported to develop local reactions several days after a combined rhinotracheitis-calicivirus vaccine.<sup>4</sup> In the late 1980s, the Laboratory of Pathology at the University of Pennsylvania School of Veterinary Medicine identified an increase in inflammatory injection site reactions in canine and feline biopsy specimens submitted to the lab.<sup>5</sup> A questionnaire sent to veterinarians confirmed that these reactions were in sites of subcutaneous administration of rabies vaccine.<sup>5</sup> All animals had been injected subcutaneously with rabies vaccine or a combination of rabies and other vaccines approximately 2 weeks to 2 months before the reaction.<sup>5</sup> The histopathologic appearance of the lesions in both species was similar. The lesions were well-circumscribed, firm dermal or subcutaneous masses with a variable, peripheral mononuclear leu-

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