Characterization of BPV-like DNA in equine sarcoids

J. A. Angelos1, E. Marti2, S. Lazary2, and L. E. Carmichael1

1 James A. Baker Institute for Animal Health, New York State College of Veterinary Medicine, Cornell University, Ithaca, New York, U.S.A.
2 Institute for Animal Breeding, University of Berne, Berne, Switzerland

Accepted November 23, 1990

Summary. The DNA from equine sarcoid samples from New York State and Switzerland was isolated and probed with bovine papillomavirus type 1 (BPV-1) to determine if BPV genomes were present. Twelve of 13 sarcoids from New York State and 17/20 sarcoids from Switzerland contained DNA that hybridized to the BPV-1 probe. Restriction enzyme analysis of the positive samples demonstrated restriction fragment profiles characteristic of BPV-1 in 22 sarcoids and restriction fragment profiles characteristic of bovine papillomavirus type 2 (BPV-2) in 7 sarcoids. In addition, three tissues histologically diagnosed as pyogranulomatous dermatitis, fibropapilloma, and fibrosarcoma contained BPV-like DNA. Tissues with BPV-1-like and BPV-2-like DNA contained an average of 285.7 (21 to 808) and 125.8 (2 to 762) BPV-like genomes per cell, respectively. Minor differences in the restriction fragment profiles of the BPV-like DNA and evidence for partial BPV-like genomes were found in some sarcoids. BPV-like DNA was not detected in lymphocyte DNA from sarcoid-affected horses. These results confirm previous observations and support the hypothesis that bovine papillomavirus, or a very similar virus, is linked to the cause of equine sarcoid.

Introduction

Sarcoids are benign skin tumours of horses, donkeys, and mules [10, 22] of any age and are among the most commonly diagnosed skin tumours of horses [9, 28]. They can occur as single or multiple tumours anywhere on the body; however, the head and neck, ventral abdomen, and limbs are most commonly affected [9, 10]. Sarcoids are classified into 4 categories based on clinical appearance: verrucous, fibroblastic, mixed verrucous and fibroblastic, and flat [25, 28]. Verrucous and flat sarcoids, however, can develop into fibroblastic sarcoids following surgical manipulation, punch biopsy, or trauma [25, 28].

Sarcoids may appear to occur spontaneously [22], or at the site of a previous
skin injury (castration or laceration sites, for example) [28]. The tumours can spread from the head to the abdomen or limbs by direct contact, or by contact with saddles, bridles, or animal handlers. These observations, along with a reported outbreak of sarcoid in a herd of horses [27], suggest that sarcoid tumours are caused by an infectious agent [10, 23].

An association between the Major Histocompatibility Complex in horses, the Equine Lymphocyte Antigen (ELA) system, and predisposition to sarcoids was recently identified in European riding horses [17] and Thoroughbreds from the United States [20]. In those studies, certain ELA antigens were found more frequently in sarcoid-affected horses than in control horses. One retrospective study found that Quarter Horses and Standardbreds have twice the risk and half the risk, respectively, of developing sarcoid tumours relative to Thoroughbreds [3].

A causal relationship between equine sarcoids and bovine papillomavirus was first suggested in 1951 [24]. In that study, horses injected intradermally with bovine wart material developed nodules that were histologically similar to sarcoids. Young ponies injected with suspensions of bovine papillomas (bovine papillomavirus, BPV; family Papovaviridae) developed localized fibroblastic tumours that were histologically indistinguishable from equine sarcoids 6 months after inoculation [30]. Horses injected intradermally with BPV, but not horses with naturally occurring sarcoid, however, developed neutralizing antibodies to BPV [29, 31].

Studies that employed DNA-DNA reassociation kinetics indicated that naturally occurring equine sarcoids contain DNA sequences of BPV [15]. Moreover, several BPV types (BPV-1, BPV-2; possibly, another BPV type) have been demonstrated in sarcoids [16]. The BPV DNA in sarcoids exists episomally as non-integrated circular molecules [1]. In Australia, 12 of 14 sarcoids contained DNA which hybridized to a BPV-1 probe, however, the papillomavirus DNA in four of these sarcoids did not have restriction fragment profiles characteristic of BPV-1 or BPV-2 [32].

In this study, sarcoids from horses in New York State and Switzerland were analyzed to determine whether DNA sequences were present that hybridized to a BPV-1 probe. Most sarcoids contained such sequences; restriction enzyme analysis of these sarcoids demonstrated restriction fragment profiles characteristic of either BPV-1 or BPV-2.

**Materials and methods**

**Source of materials**

Bovine warts caused by BPV-1 were obtained from Dr. C. Olson (University of Wisconsin). Sarcoid tumours, other equine skin lesions, and bovine warts caused by BPV-2 were obtained from Drs. W. Rebhun and R. Hillman (New York State College of Veterinary Medicine, Large Animal Clinic and Ambulatory Service) and from private veterinarians. Sarcois, other equine skin lesions, and DNA from lymphocytes of sarcoid-affected horses were also obtained from Prof. S. Lazary and Dr. E. Marti (University of Berne, Switzerland). Tissues were stored at -70°C until used.