The Hypersensitivity of Horses to *Culicoides* Bites in British Columbia

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Abstract

***Culicoides* hypersensitivity is a chronic, recurrent, seasonal dermatitis of horses that has a worldwide distribution, but has only recently been reported in Canada. It is characterized by intense pruritus resulting in lesions associated with self-induced trauma.**

A survey of veterinarians and horse-owners in British Columbia showed no differences in susceptibility due to the sex, color, breed, or height of the horses. The prevalence of the disease in the 209 horses surveyed was 26%. Horses sharing the same pasture could be unaffected. The disease was reported primarily from southwestern British Columbia; it occurred between April and October and usually affected the ventral midline, mane, and tail. Horses were generally less than nine years old when the clinical signs first appeared ($\bar{x} = 5.9$ yr). *Culicoides* hypersensitivity was common in the lineage of several affected horses, possibly indicating a genetic susceptibility. Most cases were severe enough to require veterinary attention and some horses were euthanized.

Résumé

Réaction d'hypersensibilité aux morsures de *Culicoides* chez le cheval en Colombie-Britannique

La réaction d'hypersensibilité à *Culicoides* causant une dermatite chronique, récurrente et saisonnière chez le cheval est répandue à travers le monde mais n'a été que récemment rapportée au Canada. Cette condition est caractérisée par un prurit intense, ce qui pousse l'animal à l'automutilation.

Une enquête faite auprès des vétérinaires et des propriétaires de chevaux de la Colombie-Britannique ne démontra aucune différence de susceptibilité reliée au sexe, à la couleur, à la race ou à la taille des chevaux. L'incidence de la maladie lors d'un relevé sur 209 chevaux était de 26%. Les chevaux provenant du même pâturage n'étaient pas nécessairement tous affectés. La maladie fut surtout rencontrée dans la région sud-ouest de la Colombie-Britannique; elle se manifesta durant la période d'avril à octobre et affectait généralement la ligne médiane ventrale, la crinière et la queue. A l'apparition des signes cliniques, les chevaux étaient généralement âgés de mois de neuf ans ($\bar{x} = 5,9$ ans). On nota aussi que la réaction d'hypersensibilité à *Culicoides* était fréquente dans certaines lignées de chevaux indiquant une prédisposition génétique possible. La sévérité de la plupart des cas rapportés justifia l'intervention d'un vétérinaire et on a même dû procéder à l'euthanasie de quelques chevaux.

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Introduction

Culicoides (Diptera:Ceratopogonidae) hypersensitivity (CH), also called "sweet itch", "summer mange", "summer eczema" or "Queensland itch", is a chronic, recurrent, seasonal dermatitis of horses. It is caused by the bites of female biting midges. Seasonal dermatitis of the horse has been reported worldwide (1). The name "sweet itch" is thought to be derived from the term "sweat itch" (2), probably because the pruritus intensifies when the animal is hot and sweating.

History

Many different causes have been postulated for the disease. It was first thought to be caused by fungi (3), then by *Habronema* larvae (4) and later by the microfilariae of *Onchocerca cervicalis* (5,6). This was later disproved (3,7,8,9,10) and onchocerciasis and CH are now accepted as separate and distinct conditions. Other suggested causes include poor diet, adverse climate, unhygienic conditions, renal, hepatic or splenic disorders, lack of work (5), feed allergy (11,12), and photosensitization (12).

Bancroft (13) observed in 1891 that affected horses in Australia recovered when stabled at night. The CH lesions have frequently been correlated with the appearance of bloodsucking insects (14) and the highest numbers of affected horses have been found near rivers and swamps (7), which are breeding grounds for biting insects. Several species of *Culicoides*, in particular *C. peregrinus* and *C. obsoletus*, were found on affected horses in Japan (15). In Germany, horse owners did not relate the presence of flies to "summer eczema", but Becker (11) considered it likely that "tiny flies" would go unnoticed, and that they might be responsible. In 1954, Riek (3) postulated that a biting insect was the causal agent. Intradermal skin tests with an extract of *Culicoides robertsi* were consistently positive in affected horses and consistently negative in normal horses (3). Extracts from other species of biting fly were inactive. After injection of *C. robertsi* extract, the horses had lesions and blood histamine levels identical to those seen in naturally occurring cases of the disease. Riek (3) concluded that Queensland itch was associated with the development of a hypersensitivity to the bites of *C. robertsi*. This species is most active between 1600–0700 h, which would account for Bancroft's (13) observation that affected horses recovered when stabled at night.

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It has been proposed that *Culicoides* are responsible for the disease in southwestern British Columbia (1). *Culicoides obsoletus* seemed the most likely candidate, as it is, by far, the most common species in southwestern B.C., representing 99.3% of *Culicoides* caught in light traps (16).

Clinical Signs and Pathology

Culicoides hypersensitivity is a type I (immediate) hypersentivity (17,18), with some horses showing both immediate and delayed reactions (10,19). *Culicoides* hypersensitivity is characterized initially by numerous papules, tufted hair, and hyperesthesia. This is followed by intense pruritus and self-excoriation, leading to serous effusion, localized alopecia, and the development of secondary lesions (1,20,21). Subepidermal edema occurs with congestion and perivascular cuffing of dermal vessels. Many eosinophils infiltrate the dermis, with some neutrophils and fibroblasts. The epidermis is abraded and shows acanthosis and local parakeratosis (21). The signs only occur when the horses are pastured, not stabled, and only some horses in a herd are affected; these being affected year after year. Recurrent attacks lead to hyperkeratosis, scaling, and the formation of transverse ridges in the skin (20,21).

Other dermatoses, such as cutaneous onchocerciasis, focal ventral midline dermatitis and oxyuriasis, are sometimes confused with CH. However, they can be differentiated. Cutaneous onchocerciasis is generally nonseasonal and only mildly pruritic (22), and there is a predilection for unpigmented areas of the face (23). However, as *Onchocerca cervicalis*, the nematode causal agent, is transmitted by *Culicoides* species, the diseases may coexist in one animal (23). Focal ventral midline dermatitis is caused by the bites of the hornfly, *Haematobia irritans*. It is seasonal, but lesions are usually found only in the umbilical region (22). Also, hornflies are obligate parasites of cattle and the adult fly remains on the host (24). Thus, only horses pastured with cattle are likely to be attacked. The pinworm, *Oxyuris equi*, causes rubbing only at the base of the tail, is not seasonal, and occurs mainly in stabled horses with a history of poor deworming programs (25).

Prevention

Adult *Culicoides* attack after 1600 h, are active during the early hours of the night and disappear shortly after daylight (26). Most species are crepuscular (most active at dusk or dawn) (27,28,29). It has been recommended that a susceptible horse should be stabled from 1600–0700 h throughout the warmer months. This is an effective, but demanding preventive measure (8,10,12,26,30). The use of a very fine mesh on all openings in the stable will also increase the barrier (21,31,32), but few *Culicoides* seem to penetrate an unscreened stable.

Although stabling is usually an effective preventive measure, it is often difficult or impossible to carry out. After one bite by *Culicoides*, the blood histamine level increases and does not return to normal for 1 h (33). One night's exposure may result in signs that take three to six weeks to regress, even if the horse is consistently stabled after the exposure (32).

Various materials, including oils and liniments that are used to alleviate discomfort (2,11,34,35), are often ineffective cures but may create physical or repellent barriers through which the minute insect cannot penetrate. Chemical repellents have been tested (26,36) and some show promise (12,37,38) but none is registered for use on horses in Canada under the Pest Control Products (P.C.P.) Act. However, they could be used with special minor use or experimental permits issued by Agriculture Canada, Ottawa.

Environmental control measures for *Culicoides*, including larvicidal and adulticidal chemicals, have succeeded in lowering *Culicoides* populations, but are expensive and only partially effective. *Culicoides* can breed in moist ground, drainage pipes, run-off ditches, decaying vegetation, salt marshes, and even running water (27), and can be found in horse troughs, small streams and creeks that supply the horse with drinking water.

Treatment

Antihistamine drugs can be used with benefit in the treatment of CH (39), but they have a narrow spectrum of activity — blocking histamine alone (40). Type I hypersensitivity reactions are promoted by a combination of numerous chemical mediators including histamine, serotonin (5-hydroxytryptamine), kinins, prostaglandins and related lipids, and others (17,18). Antihistamines thus have limited clinical usefulness (40).

Glucocorticosteroids are anti-inflammatory drugs and can sometimes be used in the successful treatment of CH (1,21). There are several drawbacks to the use of long-acting corticosteroids, such as suppression of the immune system which may lead to secondary infection. Or they may potentiate sympathetic vasoconstriction in the hoof and so lead to acute vascular changes resembling laminitis. Moreover, prolonged steroid therapy can result in adrenal suppression, and the sudden withdrawal of steroids can precipitate Addison's syndrome (40).

A marked reduction of clinical signs was sometimes noted when ivermectin, an antihelmintic, was given (Kleider, N. Unpublished observation).

Survey
Materials and Methods

Two different questionnaires were distributed in B.C.: one to veterinarians with practices partially or entirely restricted to horses, and the other to owners of affected horses. Thirty veterinarians in the Lower Mainland and Vancouver Island area were contacted with the aid of the British Columbia Veterinary Medical Association (B.C.V.M.A.). Fifteen had CH cases and these practitioners were sent questionnaires. Owners of affected horses were contacted with the aid of: the Canadian Thoroughbred Horse Society, the British Columbia Horse Owners Association, the British Columbia Quarter Horse Society, the Arabian Horse Enthusiasts of British Columbia, the Dogwood Buckskin Association, the British Columbia Combined

Training Association, and the magazine "Equinenews", all of which are distributed throughout the province.

The questionnaires asked for the age, sex, color, breed, and height of any affected horses; the site and duration of the lesions; age at which symptoms first appeared; presence or absence of nonaffected horses; affliction of any related horses; and the current and past localities where the horses were kept. The questionnaires were followed up by telephone interviews, during which the owners were asked the number of unaffected horses sharing the same pasture and their age, sex, color, breed and height, and also how severe the problem was. Horses were judged to be severely affected if a veterinarian had been called and a course of treatment had been recommended, or if the horse was unrideable when affected, or both. They were considered to be mildly affected if all the clinical and historical signs were consistent with CH, even if a veterinarian was not called.

The data on age, sex, color, breed, and height were analysed using a χ^2 test (41,42). Significant differences were assumed at $p \leq 0.05$.

TABLE 1
***Culicoides* Hypersensitivity in Copastured Horses as Compiled from a Survey of Veterinarians and Horse Owners in British Columbia**

General Criteria	Specific Criteria	Total Horses (n)	% Affected[a]
Sex	male	53	28.3
	female	62	30.6
Color	dark	83	31.3
	light	35	28.6
Breed[b]	Thoroughbred	13.5	33.3
	Quarter Horse	30	26.7
	Morgan	15	36.7
	Arabian	15.75	34.9
	Appaloosa	15.5	32.3
Height	ponies	31	22.6
	horses	78	35.9

[a]None of the differences was significant at a level of $p \leq 0.05$ from χ^2 calculated on raw data
[b]Horses that were crossed between two breeds are marked in both categories as 0.5

Results

Six veterinarians replied to our questionnaire and gave details of 18 affected horses; 39 horse owners replied and gave details of 54 affected horses and 155 nonaffected horses. Any horses referred to by both a veterinarian and an owner were included only once. Percentages were calculated from the number of answers to a particular question, not necessarily from the entire sample. Most cases of CH were reported from the Lower Fraser Valley in the southwestern region of B.C. (Figure 1). The prevalence of CH amongst horses in this survey was 26% (54/209).

The age at which a horse first became affected varied greatly, but most showed clinical signs before the age of nine years ($\bar{x} = 5.9$ yr). The age at onset of the clinical signs ranged from 70 days to 23 years.

No statistically significant correlation was found between CH and sex, color, or breed of the horses. Horses and ponies were equally susceptible to CH (Table 1).

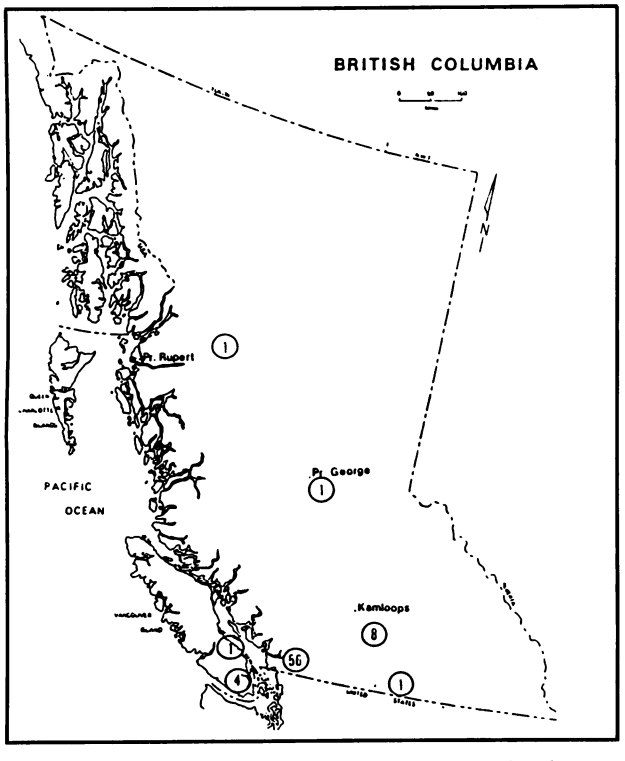

Figure 1. Distribution of reported *Culicoides* hypersensitivity cases in British Columbia (Number of cases in circles).

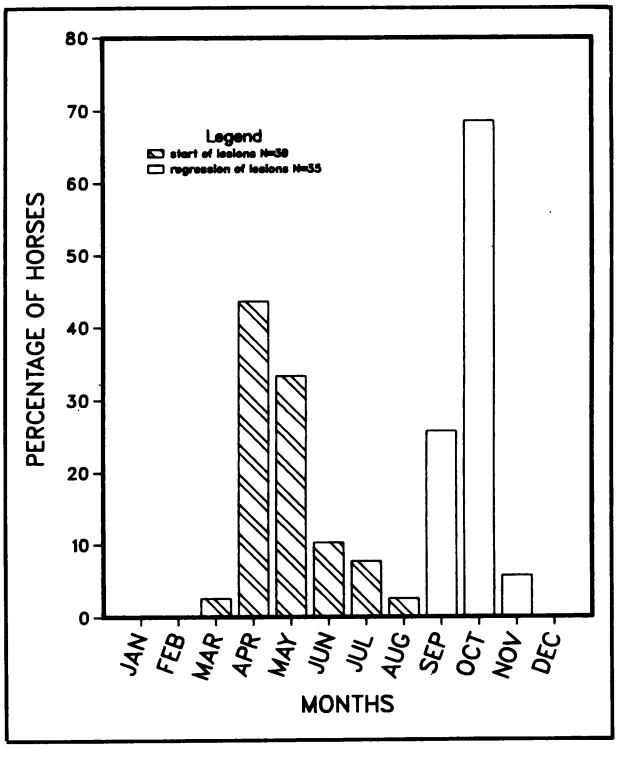

Figure 2. Seasonal onset and regression of *Culicoides* hypersensitivity in horses in British Columbia.

Of 39 affected horses, 94% had clinical signs only in the summer, and 73% developed lesions in April or May (Figure 2). Only 6% still had clinical signs by September or October. The most frequently affected areas of the body were the ventral midline (83%), the mane (50%), and the tail (46%) (Figure 3).

Most of the affected horses in our survey (89% of 72) were kept in the same enclosure and under the same conditions as one or more nonaffected horses.

In most cases (81% of 54), owners did not know the ancestry of their horse, but in all the cases where the owner did know the ancestry, an affected dam, sire, sibling or offspring was identified.

Most of the affected horses in this survey were severely affected by CH (72% of 64) and warranted treatment. Four horses were euthanized because of the disease. In 5% of all the cases, the horses were only mildly affected.

Discussion

Most cases reported by owners across B.C. were from the southwestern region; it is, therefore, possible that the causal agent, *Culicoides obsoletus*, is most abundant in this area or that most horses are kept in this area or both. A census is not available giving data on numbers of horses in different areas of B.C., and province-wide trapping data are not available. To date, trapping has been carried out mostly in the Fraser Valley (Lower Mainland Region) and in the Okanagan Valley (Interior). *Culicoides obsoletus* was the most common species of this genus trapped in the Fraser Valley (16), whereas in the Okanagan, *C. variipennis* was common and *C. obsoletus* rare (43).

The prevalence of CH in our survey in B.C. is 26%. However, this survey does not represent the general population of horses in the province but only identifies horses belonging to cooperating owners with at least one animal with this disease. Previous surveys in Germany and Israel reported prevalence of 29% and 22% respectively (11,44). Reports elsewhere suggest that overall prevalence is much lower, being 0.3% in Britain in all horses (45), 2.85% in ponies in Britain (46), and 4.43% in Hokkaido, Japan (14). In Queensland, Australia, however, 32% of the horses examined had the disease, and in one area of Queensland, over 60% were affected (20).

The age at which a horse first became affected with CH varied greatly. Previous reports have stated that a horse first exhibits clinical signs between two and four years (14,32,44,46,47). Some horses were as young as eighteen months when signs appeared (10), but, in all cases, one season of exposure was thought to be necessary for them to become sensitized. The youngest affected horse in our survey was a 70-day-old filly, which is the youngest reported case of CH worldwide. *Culicoides* hypersensitivity has been described in a four-month-old colt in Australia (20). However, these cases in foals are unusual. Some horses did not show clinical signs until they were seventeen years old. Previous observation has shown that a horse may outgrow the disease (48). One mare in our survey developed lesions at five years, suffered severely for several years, exhibited less severe clinical signs by nine years, and was only midly affected at eleven years.

Our finding of no sex predisposition to CH concurs with previous reports (1,7,12,20,21,32,47). However, geldings were found to be more frequently affected than mares or stallions in Germany (11), and Israel (44). Three affected geldings in our survey were known to have been affected both before and after castration.

Dark and light-colored horses were equally affected and this concurs with some previous reports (3,47). Other reports state that dark-colored horses are more commonly affected (7,11,14,44). However, in some cases (7,14), all the surveyed horses were of one type, grade Percherons, which are predominantly dark. This may also be influenced by differences in the behavior of the different species of *Culicoides* that cause the disease.

When an adequate sample size allowed analysis by breed (Thoroughbred, Quarter Horse, Morgan, Arabian, Appaloosa, being the most common breeds in B.C.), a predilection by breed did not appear. This supports some previous reports (20,21). In Japan, nearly all affected horses were found to belong to the "heavy draft or carriage type" but the data were confined to working agricultural horses, represented almost entirely by grade Percherons (14). In Britain, only 2% of those affected with CH were heavy horses (45), however, the percentage of heavy horses in the equine population was not reported. Frequent occurrence of the disease in Hackney horses and ponies was reported in Britain (12), but supporting data were not presented.

Similar proportions of both horses and ponies were affected in our sample from B.C. However, previous reports from Britain, Israel, and Hong Kong state that CH is a disease only of ponies ($\leq$14.2 hands high) (44,45,46). However, in one report, the distribution of nonaffected horses and ponies was not taken into account (45) and in another (44) the sample used was too small to be analyzed by the method described (41,42).

Culicoides hypersensitivity usually occurs only in the summer, coinciding with the biting insect season. Lesions usually develop when the first adults emerge and regress when the cold weather kills the remaining

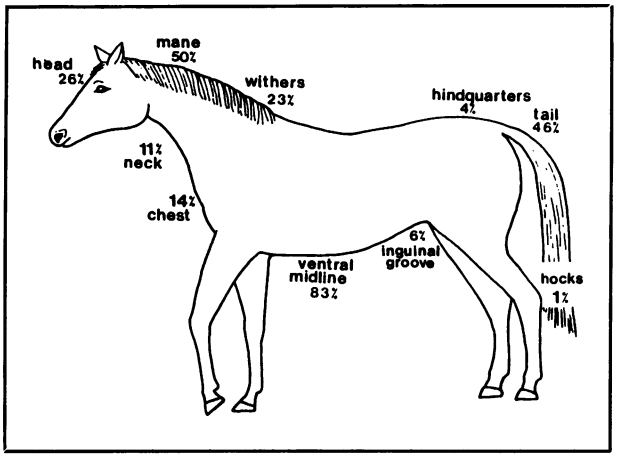

Figure 3. Distribution of *Culicoides* hypersensitivity lesion sites on affected horses in British Columbia. The percentages total >100%, as most horses are affected at multiple sites.

insects. The allergy is so intense in some chronic cases that clinical signs may persist all year (1,20,31, Braverman Y, Personal communication).

In previous reports of CH from other regions of the world, the mane and tail are most frequently affected, with the ventral midline very rarely involved (8,10,14, 20,39,49). However, in our survey the ventral midline was the most frequently affected site. The lesions evidently occur where the particular species of *Culicoides* bite. *Culicoides obsoletus* bites most often in the ventral midline region (8) explaining the distribution in Figure 3.

Most owners did not know of their horses' antecedents. However, in all cases where the owner did know this, an affected relative was identified. This implies to us, as it has to others previously, that there may be a genetic predisposition to CH (12,20,50). In Australia, Queensland itch had a familial incidence which correlated more with the dam than the sire (20). In Japan, a predisposition for summer mange, a disease presumed to be caused by *Culicoides* bites, is thought to be heritable *via* the sire's line (50). However, the authors' discussion of their data was contradictory. There are insufficient data at present to determine the type of inheritance involved.

The severity of the disease varies greatly from mild to very severe. As mild cases often pass unnoticed, the number of cases in B.C. is possibly much higher than would appear from this survey.

Acknowledgments

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Abstract

Minimal Inhibitory Concentrations of Antimicrobial Agents Against *Actinobacillus pleuropneumoniae*

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Forty-five isolates of *Actinobacillus pleuropneumoniae* were tested for susceptibility to 12 antimicrobial agents using a microdilution method for the minimal inhibitory concentration determinations. These results confirmed the high prevalence of *A. pleuropneumoniae* strains resistant to antibiotics as reported earlier using the disc diffusion method (Kirby-Bauer method).

While 36% of the isolates were resistant to the penicillins, 47% were resistant to chloramphenicol and 68% were resistant to tetracycline. Minimal inhibitory concentrations for the resistant isolates were approximately 32 times higher than those for the susceptible isolates to the above antibacterial agents. The isolates were in general weakly susceptible or resistant to spectinomycin, lincomycin, tiamulin and spiramycin whereas most of them were susceptible to gentamicin, trimethoprim and erythromycin. The susceptibility pattern was similar throughout the 1980 to 1984 period. The 14 serotype 5 isolates were more resistant to tetracycline but less resistant to chloramphenicol and the penicillins than the 28 serotype 1 isolates.

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