

An open study to evaluate topical treatment of equine chorioptic mange with shampooing and lime sulphur solution

S. Paterson* and K. Coumbe[†]

*Rutland House Veterinary Referral Hospital, St Helens, Merseyside, UK

[†]Bell Equine Hospital, Maidstone, Kent, UK

Correspondence: S. Paterson, Rutland House Veterinary Referral

²Hospital, St Helens, Merseyside, UK. E-mail: vet.pat@nildram.co.uk

Funding

This study was self-funded.

Conflict of Interest

S. Paterson is a veterinary advisor to Dermapet UK.

Abstract

Chorioptic mange caused by *Chorioptes bovis* is a common pruritic skin condition of the horse. This surface-browsing parasite usually affects the lower legs (leg mange) but can present as a generalized skin disease. Numerous anecdotal reports exist in the literature about the benefit of lime sulphur as a treatment for surface ectoparasites in the horse. This report studies the use of lime sulphur when applied as a 5% solution, some with and some without prior shampooing and clipping, to treat confirmed cases of chorioptic mange in 22 horses. Horses included in the trial had clinical signs indicative of chorioptic mange and positive identification of chorioptic mites on skin scrapings and tape preparations. Each horse was treated with sulphurated lime dip solution four times at 7-day intervals. Most horses were clipped and/or shampooed prior to treatment. Animals were assigned a score based on a scale of 1–10 to assess the severity of their lesions and degree of behavioural signs. The horses were again scored and examined for mites after four treatments. All animals showed a reduction in scores at the end of the trial and mites were not demonstrated from any animal.

Accepted 30 September 2009

Introduction

Chorioptic mange is a common pruritic equine skin disease caused by *Chorioptes bovis*. Although it can affect any horse, it frequently affects draft breeds, where it typically causes pruritic pastern dermatitis. It is also recognized as a cause of generalized skin disease, especially in young horses where it should be considered as an important differential diagnosis for pruritus. It is a difficult disease for veterinary surgeons to manage due to the

paucity of safe, cost effective and efficacious drugs. Currently, there are no drugs licensed to treat chorioptic mange in the UK. Several studies have been published which evaluate the efficacy of a variety of topical and systemic drugs. Topical drugs that have been investigated include selenium sulphide (Seleen, Ceva)¹, fipronil (Frontline, Merial)^{2–4} and ivermectin (Panomec, Merial).⁴ Systemically administered medications include oral ivermectin (Eqvalan, Merial)^{4,5}, and injectable doramectin (Dectomax; Pfizer).³ This paper describes the successful therapy of 22 cases of confirmed equine chorioptic mange, that had previously failed to respond adequately to one or all of a variety of ectoparasitic therapies, with topical therapy including 5% lime sulphur (Lime Plus dip, Dermapet; Potomac, MD, USA) used once weekly for four applications.

Materials and methods

Inclusion/exclusion criteria

Horses included in the study were referred to one of the two authors at their respective clinics between January 2007 and March 2008. All horses had a history of chorioptic mange which had been present for more than 12 months' duration and had failed to respond to other therapies (Tables 1 and 2). A definitive diagnosis of chorioptic mange was made on the basis of identification of chorioptic mange mites on skin scrapings and acetate tape preparations. All horses included were generally healthy based on a thorough physical examination. None of the horses had received any ectoparasiticide or endoparasiticide therapy for 3 weeks prior to the trial. All horses were stabled individually and all tack, brushes and rugs were kept specifically to each horse. Stables were not disinfected. No horse-to-horse contact was allowed, but horses still had access to communal areas within the stables. Although it was considered desirable, animals were not excluded if they could not be clipped and shampooed prior to application of the lime sulphur. However, in fractious horses that could not be clipped or shampooed, careful assessment was made by the attending veterinary surgeons to ensure the owners were able to apply the lime sulphur as directed. Horses with exuberant granulation tissue or tuberos lesions like those seen in chronic progressive lymphoedema were excluded, as were horses where anti-inflammatory therapy in the form of glucocorticoids or nonsteroidal anti-inflammatory drugs had been administered in the three weeks prior to therapy. Concurrent antibiotic treatment was allowed.

Assessment of lesions

Horses were divided based on the distribution of clinical signs, into group A (clinical signs confined to the legs, i.e. pastern dermatitis) and group B (generalized pruritus). Horses in group A were scored for degree of pruritus based on a pruritus scale (Table 3) from 1 to 10 at the beginning of the trial and again at the end after 4 weeks of therapy. Scoring was made by the attending veterinary surgeon based on a history taken from the owner and a dermatological examination made by the veterinary surgeon in each case. Horses in group B used

	V	D	E	8	5	5		Dispatch: 22.10.09	Journal: VDE	CE: Balaji Prasad
	Journal Name			Manuscript No.				Author Received:	No. of pages: 7	PE: Durairaja

Table 1. Treatment history and protocol, group A

Case	Previous therapy	Treatment
1	Fipronil spray, s/c injections doramectin × 2	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
2	Fipronil spray, s/c injections doramectin × 2	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
3	Fipronil spray, s/c injections doramectin × 2	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
4	Fipronil spray, s/c injections doramectin × 2	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
5	Fipronil spray, s/c injections doramectin × 2	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
6	S/c injections doramectin × 3, s/c injection dexameth × 2 dexameth/fusidic acid gel, selenium sulphide shampoo	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
7	Fipronil spray, s/c injections doramectin, oral ivermectin, selenium sulphide shampoo, chlorhexidine/miconazole shampoo	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
8	S/c injections doramectin, dexameth/fusidic acid gel, silver sulphadiazine cream, chlorhexidine/miconazole shampoo	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
9	Fipronil spray, s/c injections doramectin, oral ivermectin	Legs clipped. Shampoo benzoyl peroxide followed by lime sulphur
10	Fipronil spray, s/c injections doramectin, oral ivermectin	Legs clipped Shampoo benzoyl peroxide followed by lime sulphur
11	Fipronil spray, s/c injections doramectin	Legs no clipping or shampoo Lime sulphur dip applied directly to legs
12	Fipronil spray, s/c injections doramectin	Legs no clipping or shampoo Lime sulphur dip applied directly to legs
13	Fipronil spray, s/c injections doramectin	Legs no clipping or shampoo Lime sulphur dip applied directly to legs
14	S/c injections doramectin × 2, oral ivermectin	Legs no clipping or shampoo. Lime sulphur dip applied directly to legs
15	Fipronil spray, s/c injections doramectin × 3, oral ivermectin	Legs no clipping or shampoo. Lime sulphur dip applied directly to legs
16	Fipronil spray, s/c injections doramectin × 3, oral ivermectin	Legs no clipping or shampoo. Lime sulphur dip applied directly to legs
17	Fipronil spray, s/c injections doramectin × 12	Legs no clipping or shampoo. Lime sulphur dip applied directly to legs

Alphabetical key to products: Acetic acid:boric acid shampoo – Malacetic (Dermapet); Benzoyl peroxide shampoo – Paxcutol (Virbac); Chlorhexidine:miconazole shampoo - Malaseb (Dechra); Chlorpheniramine – Piriton (GlaxoSmithKline); Dexamethasone: fusidic acid gel – Fuciderm (Dechra); Doramectin – Dectomax, (Pfizer); Fipronil – Frontline spray (Merial); Hydroxyzine – Atarax (Alliance Pharmaceuticals); Ivermectin – Eqvalan (Merial); Lime sulphur dip – Lime plus dip (Dermapet); Selenium sulphide shampoo – Seleen (CEVA); Silver sulphadiazine cream – Flamazine (Smith and Nephew).

a different pruritus scoring table (Table 4) but were also assessed by the investigating veterinary surgeon and the owner.

Diagnostic investigation

In all cases a detailed general and dermatological history was taken as well as performing a full physical and dermatological inspection. Details of clinical signs and previous treatments are recorded in Tables 1, 2, 5 and 6. Surface skin samples were collected using a tongue depressor or scalpel blade, by scraping crust and scale from the posterior aspect of the pastern (group A) and from the flanks and lower legs (group B). The perianal fold, which is recognized as a site where chorioptic mange mites can be found, was not sampled due to the fractious nature of some of the horses and the unavailability of sedation or stocks to guarantee investigator safety in some cases. Acetate tape preparations were also collected from the same sites. Skin scrapings and tape preparations were repeated from the same

sites on each horse at the end of the treatment period. In group A the most severely affected leg was sampled. Skin scraping samples were mounted in 10% potassium hydroxide and examined microscopically; tape preparations were mounted directly onto slides and examined. In cases 6–10 and 14–22 samples of crust and scale were also submitted for bacterial and dermatophyte culture.

Protocol for topical treatment

Group A

The pasterns were clipped, where necessary under sedation using a combination of detomidine hydrochloride (Domosedan; Pfizer), 10 µg/kg intravenously with butorphanol (Torbugesic; Fort Dodge) 25 µg/kg intravenously.

The legs were wetted with warm water and benzoyl peroxide shampoo (Paxcutol, Virbac) was rubbed well into the lower legs, up a

Table 2. Treatment history and protocol, group B

Case number	Previous treatments	Treatment
18	Doramectin s/c, dexamethasone s/c, chlorhexidine/miconazole shampoo, hydroxyzine, chlorpheniramine	Acetic acid/boric acid shampoo Lime sulphur dip, potentiated sulphonamides
19	Doramectin s/c, dexamethasone s/c, hydroxyzine, selenium sulphide shampoo	Acetic acid/boric acid shampoo Lime sulphur dip, potentiated sulphonamides
20	Dexamethasone s/c, hydroxyzine, selenium sulphide shampoo	Acetic acid/boric acid shampoo Lime sulphur dip, potentiated sulphonamides
21	Doramectin s/c × 2, dexamethasone s/c × 1, hydroxyzine, chlorpheniramine	Acetic acid/boric acid shampoo Lime sulphur dip
22	Doramectin s/c × 3, dexamethasone s/c × 2, hydroxyzine, chlorhexidine/miconazole shampoo	Acetic acid/boric acid shampoo Lime sulphur dip

Alphabetical key to products: Acetic acid:boric acid shampoo – Malacetic (Dermapet); Benzoyl peroxide shampoo – Paxcutol (Virbac); Chlorhexidine:miconazole shampoo - Malaseb (Dechra); Chlorpheniramine – Piriton (GlaxoSmithKline); Dexamethasone: fusidic acid gel – Fuciderm (Dechra); Doramectin – Dectomax, (Pfizer); Fipronil – Frontline spray (Merial); Hydroxyzine – Atarax (Alliance Pharmaceuticals); Ivermectin – Eqvalan (Merial); Lime sulphur dip – Lime plus dip (Dermapet); Selenium sulphide shampoo – Seleen (CEVA); Silver sulphadiazine cream – Flamazine (Smith and Nephew).

Table 3. Pruritus score for horses with pastern dermatitis

Score	Clinical signs
1	Horse not foot stamping, not seen to be chewing at legs, will tolerate legs being touched. Minimal scaling without excoriation on the caudal aspect of pasterns. Legs deemed to be normal
2	Horse foot stamping rarely, not seen to be chewing at legs, will tolerate legs being touched. Mild scaling and crust without excoriation on the caudal aspect of pasterns
3	Horse foot stamping occasionally, not seen to be chewing at legs, will tolerate legs being touched. Mild scaling and crust without excoriation on the caudal aspect of pasterns
4	Horse foot stamping occasionally, not seen to be chewing at legs, will tolerate legs being touched. Moderate scaling and crust without excoriation on the caudal aspect of pasterns
5	Horse foot stamping intermittently, not seen to be chewing at legs, will tolerate legs being touched. Moderate scaling and crust without excoriation on the caudal aspect of pasterns
6	Horse foot stamping intermittently, not seen to be chewing at legs, will kick out if legs are touched. Moderate scaling and crust without excoriation on the caudal aspect of pasterns
7	Horse foot stamping intermittently, chewing at legs, will kick out if legs are touched. Moderate scaling and crust without excoriation on the caudal aspect of pasterns
8	Horse foot stamping constantly, chewing at legs, will kick out if legs are touched. Moderate scaling and crust with excoriation on the caudal aspect of pasterns
9	Horse foot stamping constantly, chewing at legs, will kick out if legs are touched. Thick scaling and crust with excoriation on the caudal aspect of pasterns
10	Horse foot stamping constantly, chewing at legs, will kick out if legs approached. Thick scaling and crust with excoriation on the caudal aspect of pasterns

level just above the carpus, for 5 min with a 10 min contact time before thorough rinsing with water. Next 50 mL of 97.8% sulphurated lime dip (Lime Plus dip; Dermapet) was diluted in 1 L of water and applied either with a sponge or with a plant sprayer to the affected area on the legs. 1 L was found to be a sufficient volume in all cases to soak all four legs in even the largest horses. The application of shampoo followed by lime sulphur application was repeated for a total of four treatments at 7-day intervals.

It was only possible to follow the full protocol (clip, shampoo, and dip) in cases 1–10. In cases 11 and 12 the owners would not consent to the horses' feathers being clipped off. Where horses resented clipping and shampooing (cases 13–17) lime sulphur was sprayed onto the legs without any prior clipping or shampoo therapy.

Group B

These horses were not clipped except in the instance of heavy feathering on their legs. They were given a full body shampoo in an acetic acid-boric acid shampoo (MalaceticEQ, Dermapet), following the same shampoo protocol as in group A, prior to application of the lime sulphur dip at the same dilution as group A. Where a litre of lime sulphur solution was not enough to wet the whole of the horse's body a further quantity of dip was made up at the same concentration to allow complete coverage of the horse. The application of shampoo followed by lime sulphur dip was repeated for a total of four treatments at 7-day intervals.

Table 4. Pruritus scores for horses with generalized pruritus

Score	Clinical signs
1	Nonpruritic
2	Very mild pruritus rare signs of rubbing and chewing without signs of alopecia or excoriation
3	Very mild pruritus occasional signs of rubbing and chewing which last for a few seconds without signs of alopecia or excoriation
4	Mild pruritus occasional signs of rubbing and chewing which can last for a few seconds without signs of alopecia or excoriation
5	Mild/moderate pruritus will rub and chew for extended periods without signs of alopecia or excoriation
6	Moderate pruritus will rub and chew for extended periods and cause signs of alopecia without excoriation
7	Moderate pruritus will rub and chew for extended periods and cause signs of alopecia and excoriation
8	Moderate/severe pruritus will rub and chew for extended periods and cause signs of alopecia and excoriation
9	Severe pruritus will rub and chew for extended periods and cause signs of alopecia and excoriation
10	Severe pruritus will rub and chew almost constantly and cause signs of alopecia and excoriation

Horses with secondary bacterial infection as identified on culture were treated concurrently with antibiotics based on susceptibility testing [trimethoprim sulphadiazine (Uniprim, Pfizer) at a dose of 30 mg/kg once daily for 3 weeks].

Reassessment of lesions

After 4 weeks all of the horses in both groups were again scored for pruritus using the previously defined scales. The final score for each horse was determined by the attending veterinary surgeon after discussion with the owner and after examining the horse.

The data from groups A and B were compared before and after treatment. Analysis of the data was performed using the Mann-Whitney U test with $P < 0.05$ being considered a significant difference.

Adverse effects

Owners were asked to record any adverse effects noted after application of topical therapy to the investigating veterinary surgeons as soon as possible.

Results

All of the horses in both groups fulfilled the inclusion criteria and chorioptic mange mites were identified from all horses at the start of the trial. Their case details and previous therapies are recorded in Tables 1, 2, 5 and 6. No bacterial infection or dermatophytes were identified from horses in group A. In three of the cases from group B (Table 6) secondary bacterial infection with coagulase positive *Staphylococcus* was identified on culture and treated concurrently. Dermatophytes were not isolated from any horse in group B.

No adverse reactions were recorded from the owner of any horse in either group. All of the horses in both groups successfully completed the 4 week course of therapy.

Skin scrapings and acetate tape preparations taken after 4 weeks of therapy for all horses failed to reveal mites. Pruritus was reduced in all horses in both groups. Approximately 88% (15/17) of the horses in group A were deemed to be completely comfortable after

Table 5. Clinical details of horses from group A

Case	Age (years)	Sex	Breed	Presenting signs	Pruritus score at start of trial
1 (2)	7	Mare	Cob	Persistent severe pastern dermatitis, foot stamping	9
2 (2)	6	Mare	Riding horse	Persistent severe pastern dermatitis, foot stamping	9
3 (2)	8	Gelding	Riding horse	Persistent moderate severe pastern dermatitis, foot stamping	9
4 (2)	16	Gelding	Shire x	Persistent moderate/severe pastern dermatitis, foot stamping	8
5 (2)	6	Gelding	Cob	Persistent severe pastern dermatitis, foot stamping	9
6	12	Gelding	Connemara	Persistent moderate/severe pastern dermatitis, foot stamping	8
7	8	Gelding	Shire	Persistent severe pastern dermatitis, foot stamping	9
8	3	Mare	Shire	Persistent severe pastern dermatitis, foot stamping	9
9	2	Gelding	Cob	Persistent severe pastern dermatitis, foot stamping	9
10	8	Mare	Cob	Persistent moderate/severe pastern dermatitis, foot stamping	8
11 (2)	4	Mare	Shire x	Persistent severe pastern dermatitis, foot stamping	9
12 (2)	5	Mare	Shire	Persistent moderate/severe pastern dermatitis, foot stamping	9
13 (2)	8	Gelding	Cob	Persistent very severe pastern dermatitis, foot stamping	10
14	11	Mare	Pony	Persistent very severe pastern dermatitis, foot stamping	10
15	12	Mare	Cob	Persistent very severe pastern dermatitis, foot stamping	10
16	15	Mare	Cob	Persistent very severe pastern dermatitis, foot stamping	10
17	8	Gelding	Friesian	Persistent very severe pastern dermatitis, foot stamping	9

4 weeks of therapy and were assigned a pruritus score of 1 (Table 7). The other two horses in this group were shown to be greatly improved and were described as being mildly pruritic. They were given a pruritus score of 2 and 3. In group B 100% of the horses responded to therapy and were allocated a pruritus score of 1 indicative of a complete resolution of clinical signs (Table 8). Assessment of the data before and after treatment using a Mann-Whitney U test revealed a significant reduction in clinical score in both groups ($P = 0.0003$ for group A and $P = 0.0431$ for group B).

Discussion

Chorioptic mange is a common equine disease which has been recognized for many years.^{6,7} It is caused by the mite *Chorioptes bovis*, a surface-inhabiting parasite, 0.3–0.5mm in length. Mites are essentially surface browsers feeding on exfoliated skin cells.⁷ They only penetrate the living epidermis in chronic disease. In such cases they can aggregate under crusts making them inaccessible to topical miticidal drugs. The pruritus they induce causes discomfort to the horse. This often leads to foot stamping and can distract from their ability to work. In severe cases self inflicted trauma leads to excoriation with further pain and chronic change such as lichenification.

Draft horses are commonly used to work and for show and the thick feathering at the backs of the pasterns,

which gives them their characteristic form and desirability as show animals, also provides an ideal environment for mite multiplication. The dense feathering traps scale which provides a rich and necessary food supply of epidermal debris for mites⁷ and also protects them from temperature extremes.⁸

The mite's life cycle is approximately 3 weeks and is completed on the host; however mites can survive for upto 69 days away from their host⁸ making environmental contamination a potential source of reinfection or infection of other horses. In this study, environmental treatment was not undertaken in any of the cases, which could have limited complete or permanent resolution. As horses were confined to their own stable and all fomites were restricted to individual horses, it was hoped that this failing would be of limited relevance. This lack of environmental treatment is often representative of the situation in practice, where owner compliance for animal treatment is usually good but for environmental decontamination is poor.

It is possible that some of the improvement in these cases may have been due to clipping of the feathering, which would have physically removed some mites from the hair coat. Although clipping is recommended as part of the treatment regime for any topical therapy, owners are often reluctant to have animals clipped, and some horses may not permit it. Some of the improvement in horses in group A may also have been due to the fact that

Table 6. Clinical details of horses from group B

Case number	Age	Sex	Breed	Clinical signs	Initial pruritus score
18	4	Gelding	Cob	Severe generalized dermatitis plus staphylococcal infection	10
19	3	Mare	Connemara	Severe generalized pruritus plus staphylococcal infection	10
20	2	Mare	Connemara	Severe generalized pruritus plus staphylococcal infection	9
21	5	Mare	Shire	Severe generalized pruritus	8
22	6	Stallion	Fresian	Severe generalized pruritus	8

Table 7. Pruritus score at inclusion and follow up group A

Case	Pruritus score prior to therapy	Pruritus score after therapy	Clinical signs
1	9	2	Resolution of signs, no pruritus or foot stamping some residual thickening of pastern skin remained
2	9	1	Complete resolution of signs
3	9	1	Complete resolution of signs
4	8	3	Marked improvement, still mild scaling at back of pasterns and occasional foot stamping
5	9	1	Complete resolution of signs
6	8	1	Complete resolution of pruritus, mild scaling at back of pasterns but no pruritus
7	9	1	Complete resolution of pruritus, mild scaling at back of pasterns
8	9	1	Complete resolution of signs of pruritus, mild scaling at back of pasterns
9	9	1	Complete resolution of signs
10	8	1	Complete resolution of signs
11	9	1	Complete resolution of signs
12	9	1	Complete resolution of signs
13	10	1	Complete resolution of signs
14	10	1	Complete resolution of pruritus, mild scaling at back of pasterns
15	10	1	Complete resolution of signs
16	10	1	Complete resolution of signs
17	9	1	Complete resolution of pruritus, mild scaling at back of pasterns

benzoyl peroxide, a keratolytic shampoo, was used, which may have physically removed scale and mites. However, some horses in group A were neither clipped nor shampooed, and were treated only with lime sulphur. The fact that these horses also responded to treatment suggests that the lime sulphur may have been the most important element of treatment.

Selection of a treatment protocol for chorioptic mange must take into account several factors. Regardless of whether therapy is administered systemically or topically, it must be capable of reaching mites, which may be inaccessible within mats and scale in the hair coat or on the surface of the skin. Application or administration of medication must also be achievable safely by an owner, even when the infested horse is highly sensitive to the application of topical medication.

Systemic ectoparasiticides that have been investigated include doramectin³ and ivermectin.⁵ These drugs' mechanism of action is to potentiate the release and the

Table 8. Pruritus score at inclusion and follow up group B

Case	Pruritus score prior to therapy	Pruritus score after therapy	Comments
18	10	1	Pruritus resolved
19	10	1	Pruritus resolved
20	9	1	Pruritus resolved
21	8	1	Pruritus resolved
22	8	1	Pruritus resolved

effects of gamma aminobutyric acid (GABA) in the central nervous system tissue of parasites leading to flaccid paralysis.¹¹ A comparative study³ using fipronil spray in a 0.25% solution and doramectin given at a dose of 0.3 mg/kg on two occasions 14 days apart by subcutaneous injection revealed both drugs to be effective in eliminating behavioural signs in affected animals. Although mite numbers were significantly reduced in both groups neither drug completely eliminated mites and there was no improvement in the appearance of the lesions themselves. In a further study⁵, ivermectin paste, given orally, was investigated using three different protocols. All of the horses improved. However despite waiting 3 weeks after therapy to assess the horses there was no significant change in their clinical scores. The advantage of systemic medication is that it negates the need to clip off hair from the pasterns and overcomes the difficulty of applying topical applications on what are often fractious horses. Despite the improvement seen in these studies, none of the drugs completely eliminated mites. This may be related to uncertainty over achieving acaricidal doses of drug within hair and crust.

Topical therapy has been described using selenium sulphide¹, fipronil^{2,3}, ivermectin solution¹³ and flumethrin.¹⁴ Reports about use of the latter two drugs are anecdotal only. Clinical studies have been undertaken to substantiate claims of efficacy for selenium sulphide and fipronil. In a pilot study reported by Curtis¹ 1% solution of selenium sulphide was used to shampoo seven horses on days 0, 5 and 10. All horses improved and after three washes were parasite free. There was a concurrent improvement in dermatological lesions including signs of hair regrowth. The ectoparasitological mode of action of selenium sulphide is unknown. It may be the sulphur content that provides it with its activity but may also be due to the keratolytic and keratoplastic activity of the shampoo, which may aid penetration of the drug into crust. The physical action of the shampooing probably contributes to the visual improvement of the lesions, a finding not reported when using systemic medication. However the task of shampooing a highly pruritic unsedated horse on three occasions may prove difficult for some owners. A limitation of all topical therapy protocols is that it is not uncommon for horses with chorioptic mange to be too uncomfortable to allow clipping and shampoo therapy. Furthermore, many owners of working and showing draft horses will not consent to clipping of the animal's feathering on their legs.

Open and comparative studies using fipronil have shown it to be a useful drug to treat chorioptic mange.^{2,3} Although therapeutic trials have shown it is successful in alleviating clinical signs, it has been shown to significantly reduce but not eliminate parasites and in studies has not produced any statistical improvement in lesion score.^{2,3} Despite the obvious benefits of fipronil application, a number of factors limit its usefulness, including the expense (approximately 500mL is needed to treat a Shire horse) and the physical difficulty in spraying large areas of a horse and/or multiple horses.¹⁴

In this study a solution of lime sulphur was used to treat horses with both localized *Chorioptes* lesions and generalized disease. All of the horses had previously

failed to respond to three other recognized ectoparasitocides (fipronil, doramectin and ivermectin). As all three of these products have been shown to be useful in the therapy of *Chorioptes* infestation^{2,3,5} there are numerous reasons why they may not have resolved the chorioptic mange. Dose rates and treatment protocols may have been inappropriate. Drugs may not have achieved adequate acaricidal concentrations in lesional areas due to the inaccessibility of the mites within crust. It is possible that *Chorioptes* mites unaffected by therapy may have recolonized the skin.

The active ingredient of sulphurated lime solution is the sulphur.¹⁵ The name is derived from the fact lime sulphur itself is a mixture of calcium polysulphides, which are formed from mixing calcium hydroxide (lime) with sulphur. Several reports have described the successful therapy of mite infestations with lime sulphur in other species.^{16,17} Sulphur is recommended by Scott¹⁸ as an inexpensive effective treatment of infestations of non-follicular mites in the horse. He describes it as being fungicidal, bactericidal, keratolytic and antipruritic. Its ability to penetrate lesions due to its keratolytic action, as well as its antiparasitic and antipruritic action makes sulphur an excellent potential topical medication to treat chorioptic mange. Scott does cite significant disadvantages of such therapy, namely, the foul smell that accompanies application and the fact the sulphur will stain white hair yellow. It is also regarded as being potentially irritating when used in concentration in excess of 5%. All of the owners in this study were made aware of the smell of the sulphur before starting on treatment as well as its ability to stain. All owners exercised care when applying medication to ensure it was not spilt onto jewellery or clothing. Although staining was very obvious in many of the horses with white feathering, the colour was observed to fade quickly after 24–48 h. Although the lime sulphur stock solution was 97.5% sulphurated lime, it was diluted down to a concentration of 5% in all cases. All of the horses tolerated therapy and no adverse reactions were reported after application of the solution. Some owners noted that spraying the solution onto the legs from a distance, without having to directly contact the horse, was an advantage.

Results of this study (elimination of mites and the improvement in the appearance of the lesions) are very similar to those reported by Curtis¹ using selenium sulphide shampoo. Selenium sulphide probably has a similar mode of action to sulphurated lime. Shampoo therapy is considerably more difficult than spray application which can be achieved quickly even in fractious horses. Numerous horses can also be treated in a short period of time with spray.

Though in this study only a small number of horses were treated, our results indicate that 5% sulphur

solution, with or without pre-treatment by clipping and shampooing, appears to be an effective treatment for chorioptic mange. There is now a need for further controlled, comparative studies using larger numbers of horses to confirm these initial findings.

Acknowledgements

The authors would like to acknowledge the help of Stephen Shaw for preparation of the statistical analysis.

References

- Curtis CF. Pilot study to investigate the efficacy of 1% selenium sulphide shampoo in the treatment of equine chorioptic mange. *Veterinary Record* 1999; 144: 674–5.
- Littlewood JD. Chorioptic mange: successful treatment of a case with fipronil. *Equine Veterinary Education* 2000; 12: 144–6.
- Rendle DI, Cottle HJ, Love S *et al.* Comparative study of doramectin and fipronil in the treatment of equine chorioptic mange. *Veterinary Record* 2007; 161: 335–8.
- Love S, Christley RM. Parasiticides. In: Bertone JJ, Horspool LJI, eds. *Equine Clinical Pharmacology*. Philadelphia, WB Saunders, 2004: 71–3.
- Littlewood JD, Rose JF, Paterson S. Oral ivermectin paste for the treatment of chorioptic mange in horses. *Veterinary Record* 1995; 137: 661–3.
- Rose AL. Leg mange or itchy heel of horses. Description of the disease and methods of treating it. *Agricultural Gazette of New South Wales* 1940; 51: 491–6.
- Sweatman GK. Life history, non-specificity and revision of the genus *Chorioptes*, a parasitic mite of herbivores. *Canadian Journal of Zoology* 1957; 35: 641–89.
- Liebisch A, Olbrich S, Deppe M. Survival of *Psoroptes ovis*, *Psoroptes cuniculi* and *Chorioptes bovis* away from the host. *Deutsche Tierärztliche Wochenschrift* 1985; 92: 181–5.
- Bergvall K. Advances in acquisition, identification and treatment of equine ectoparasites. *Clinical Techniques in Equine Practice* 2005; 4: 296–301.
- Littlewood JD. Equine chorioptic mange: an epidemiological study and controlled clinical trial. Diploma in Veterinary Dermatology Thesis. Royal College of Veterinary Surgeons, 1999.
- Pilsworth RC, Knottenbelt DC. Chorioptic Mange. *Equine Veterinary Education* 2005; 17: 116–7.
- Taylor MA. Recent developments in ectoparasiticides. *Veterinary Journal* 2001; 161: 253–68.
- Fadok VA. Ectoparasites. In: Robinson NE, ed. *Current Veterinary Therapy: Equine Practice*. Philadelphia: WB Saunders, 1987; 622–4.
- Littlewood JD. Control of ectoparasites in the horse. In *Practice* 1999; 21: 418–24.
- Gupta AK, Nicol K. The use of sulfur in dermatology. *Journal of Drugs in Dermatology* 2004; 3: 427–31.
- Malik R, McKellar Stewart K, Sousa CA *et al.* Crusted scabies (sarcoptic mange) in four cats due to *Sarcoptes scabiei* infestation. *Journal Feline Medicine and Surgery* 2006; 5: 327–39.
- McDonald SE, Lavoipierre MM. *Trixacarus caviae* infestation in two guinea pigs. *Laboratory Animal Science* 1980; 1: 67–70.
- Scott DW, Miller WH. Parasitic disease. In: *Equine Dermatology*. Philadelphia: WB Saunders, 2003; 321–75.

Résumé La gale chorioptique due à *Chorioptes bovis* est une dermatose prurigineuse fréquente chez le cheval. Ce parasite superficiel atteint en général l'extrémité des membres (gale des pattes) mais peut également se généraliser. De nombreux rapports anecdotiques existent dans la littérature sur l'utilisation du lime sulfur dans le traitement des ectoparasites externes du cheval. Cet article étudie l'utilisation du lime sulfur sous forme de solution à 5% avec ou sans shampooing et tonte préalable, dans le traitement de 22 cas confirmés de gale chorioptique équine. Les chevaux inclus présentaient des signes cliniques évocateurs. Les raclages et tests à la cellophane adhésive révélaient la présence de chorioptes. Chaque animal

1 était traité avec une solution de lime sulfur, tous les 7 jours, à quatre reprises. La plupart des chevaux était
2 tondu et shampooiné avant le traitement. Les animaux étaient évalués sur une échelle de 1 à 10 sur la
3 sévérité des lésions et leur comportement clinique. Les chevaux ont été réévalués et réexaminés après les
4 quatre traitements. Tous les animaux ont montré une diminution des scores à la fin de l'étude et les acar-
5 iens n'étaient plus retrouvés sur aucun prélèvement.

6 **Resumen** La sarna coriográfica causada por *Chorioptes bovis* es una enfermedad pruriginosa bastante
7 común en el caballo. Este parásito deambulatorio de superficie normalmente afecta la parte inferior de las
8 extremidades (sarna de las patas) pero se puede presentar como una enfermedad generalizada. Existen
9 numerosas citas anecdóticas en la literatura acerca del efecto beneficioso de la lima sulfurada en el tratami-
10 ento de parásitos superficiales en el caballo. En este estudio utilizamos lima sulfurada aplicada como solu-
11 ción al 5%, en algunos con y otros sin previo lavado y corte de pelo, para tratar casos confirmados de sarna
12 coriográfica en 22 caballos. Los caballos incluidos en la prueba tenían signos clínicos indicativos de sarna cori-
13 óptica e identificación positiva de los ácaros en raspados de piel y preparaciones de cinta adhesiva. Cada
14 caballo fue tratado tras sumergir la zona en solución de lima sulfurada cuatro veces a intervalos de 7 días. La
15 mayoría de los caballos fueron rasurados y lavados antes del tratamiento. A los animales se les asignó un
16 valor basado en una escala de 1 a 10 evaluando la severidad de lesiones y el efecto en el comportamiento.
17 Los caballos fueron de nuevo valorados y examinados para la presencia de ácaros tras los cuatro tratamien-
18 tos. Todos los animales mostraron reducción en los valores al final de la prueba y no se observaron ácaros
19 en ningún animal.

20 **Zusammenfassung** Die Chorioptesräude, welche durch *Chorioptes bovis* verursacht wird, ist eine häufi-
21 ge juckende Hauterkrankung des Pferdes. Dieser Oberflächen durchstößende Parasit befällt normalerwe-
22 ise die unteren Extremitäten (Beinräude), kann sich aber auch als generalisierte Hauterkrankung
23 präsentieren. Zahlreiche anekdotenhafte Berichte existieren in der Literatur über die Wirksamkeit von
24 Schwefelkalk (Lime Sulphur) für die Behandlung von Oberflächenparasiten bei Pferden. In diesem Bericht
25 wird die Wirksamkeit von Schwefelkalk untersucht, der als 5%ige Lösung bei manchen Pferden mit und
26 bei manchen Pferden ohne vorhergehendes Shampooieren und Rasieren aufgetragen wurde, um best-
27 ätigte Fälle von Chorioptesräude bei 22 Pferden zu behandeln. Pferde, die in die Studie aufgenommen wur-
28 den, zeigten klinische Symptome, die auf Chorioptesräude hinwiesen und Chorioptesmilben waren in
29 Hautgeschabseln und Klebestreifenpräparaten positiv identifiziert worden. Jedes Pferd wurde mit einer
30 schwefeligen Kalk-Dip-Lösung vier Mal in Intervallen von 7 Tagen behandelt. Die meisten Pferde wurden
31 geschoren und/oder vor der Behandlung shampooiert. Den Tieren wurden Grade zugeteilt, basierend auf
32 einer Skala von 1–10, um die Schwere dieser Läsionen und das Ausmaß der Verhaltensänderungen zu
33 bewerten. Nach vier Behandlungen wurden die Pferde wieder bewertet und auf Milben untersucht. Alle
34 Tiere zeigten am Ende des Versuchs eine Verminderung der Bewertungsgrade und es konnten von keinem
35 Tier Milben nachgewiesen werden.

Author Query Form

Journal: VDE

Article: 855

Dear Author,

During the copy-editing of your paper, the following queries arose. Please respond to these by marking up your proofs with the necessary changes/additions. Please write your answers on the query sheet if there is insufficient space on the page proofs. Please write clearly and follow the conventions shown on the attached corrections sheet. If returning the proof by fax do not write too close to the paper's edge. Please remember that illegible mark-ups may delay publication.

Many thanks for your assistance.

Query reference	Query	Remarks
Q1	AUTHOR: Please give full name of authors	
Q2	AUTHOR: Please provide postal codes in the affiliation/correspondence field	
Q3	AUTHOR: Please provide manufacturer information for Pfizer	
Q4	AUTHOR: Please provide manufacturer information for Fort Dodge	
Q5	AUTHOR: Please provide manufacturer information for Virbac	
Q6	AUTHOR: Please provide manufacturer information for Dermapet	

MARKED PROOF

Please correct and return this set

Please use the proof correction marks shown below for all alterations and corrections. If you wish to return your proof by fax you should ensure that all amendments are written clearly in dark ink and are made well within the page margins.

<i>Instruction to printer</i>	<i>Textual mark</i>	<i>Marginal mark</i>
Leave unchanged	... under matter to remain	Ⓟ
Insert in text the matter indicated in the margin	∧	New matter followed by ∧ or ∧ [Ⓢ]
Delete	/ through single character, rule or underline or ┌───┐ through all characters to be deleted	Ⓞ or Ⓞ [Ⓢ]
Substitute character or substitute part of one or more word(s)	/ through letter or ┌───┐ through characters	new character / or new characters /
Change to italics	— under matter to be changed	↙
Change to capitals	≡ under matter to be changed	≡
Change to small capitals	≡ under matter to be changed	≡
Change to bold type	~ under matter to be changed	~
Change to bold italic	≈ under matter to be changed	≈
Change to lower case	Encircle matter to be changed	≡
Change italic to upright type	(As above)	⊕
Change bold to non-bold type	(As above)	⊖
Insert 'superior' character	/ through character or ∧ where required	Υ or Υ under character e.g. Υ or Υ
Insert 'inferior' character	(As above)	∧ over character e.g. ∧
Insert full stop	(As above)	⊙
Insert comma	(As above)	,
Insert single quotation marks	(As above)	ʹ or ʸ and/or ʹ or ʸ
Insert double quotation marks	(As above)	“ or ” and/or ” or ”
Insert hyphen	(As above)	⊥
Start new paragraph	┌	┌
No new paragraph	┐	┐
Transpose	└┐	└┐
Close up	linking ○ characters	○
Insert or substitute space between characters or words	/ through character or ∧ where required	Υ
Reduce space between characters or words		↑