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A twenty-year retrospective study of tetanus in horses: 42 cases

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ABSTRACT

The retrospective study included 42 horses affected with tetanus and treated between 1990 and 2009. A total of 34 coldblood horses and 8 warmblood horses were included in the study. The most frequent clinical signs were rigidity of limb muscles, trismus, and nictitating membrane prolapse. The overall mortality rate was 45.3 % and the mean age of infected animals was 5.8 years. The first 7 days of disease are the most critical period for survival. A more rapid progression and the presence of recumbency and profuse sweating were confirmed as indicators of poor prognosis.

Key words: horse, tetanus, retrospective study

Introduction

Tetanus is an acute noncontagious infectious disease caused by *Clostridium tetani* (*C. tetani*) exotoxins that affects many animal species and humans (CVETNIĆ, 2002). In

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unfavorable conditions the bacterium produces highly resistant spores that can survive for years in soil, and it is sometimes also found in the gastrointestinal tract and feces of healthy horses and humans (WILKINS et al., 1988; NAGLIĆ et al., 2005; RADOSTITS et al., 2007).

Tetanus continues to be associated with a high mortality rate, ranging from 58 % to 80 % in equidae (GREEN et al., 1994; VÖRÖS et al., 1997; SMITH, 2002; VAN GALEN et al., 2008; REICHMANN et al., 2008).

The organism gains entry to the body *via* wounds. Although deep, penetrating wounds, such as punctures of the hoof capsule, are more liable to permit proliferation of *C. tetani*, even superficial wounds can provide suitable anaerobic conditions (KAY and KNOTTENBELT, 2007) required for their transition to the vegetative form and replication at the site of infection. Exotoxins are produced, the most important of which are tetanolysin and tetanospasmin (TURTON et al., 2002). Tetanolysin causes damage to viable tissue, lowering its redox potential and creating favorable conditions for the spread of anaerobic infection (COOK et al., 2001), whereas tetanospasmin enters the circulation and binds irreversibly to receptors on the motor nerve endings (ATTYGALLE and RODRIGO, 2004). The activity of these toxins leads to spastic paralysis (COOK et al., 2001).

Among animal species, the horse is considered most susceptible to tetanus toxin (MacKAY, 2007). The disease incubation takes 3-28 days (GREEN et al., 1994). The initial clinical signs manifest as spasm of the head muscles, resulting in trismus and lockjaw (BOUVIER, 1972; BEROZA, 1980). In the initial stage of the disease, touching the eyeball can cause prolapse of the third eyelid, which then returns slowly to its natural resisting position (RADOSTITS et al., 2007), whereas in the later stage the third eyelid protrusion may be permanent (GREEN et al., 1994). With progression of the disease, spasms involve the neck and the esophagus, making swallowing difficult (BROOK, 1970). Ears stand erect and immobile, and the tail-head is held elevated. In very severe cases, the horses adopt a sawhorse stance with serious dyspnea, inability to ingest food, stiff neck, and sudoresis, before becoming recumbent (JOHNSTON, 1987). Signs of the general infection syndrome and spasms of the extremity musculature develop concurrently, making movement difficult or impossible (RADOSTITS et al., 2007). Death is due to spasm of the respiratory musculature (JOHNSTON, 1987).

The diagnosis of tetanus is not usually difficult (SEDRISH et al., 1996).

The aim of the study was to assess prevalence during the 1990-2009 period, to define the particular signs of tetanus in horses and to gain an insight into the mode and efficacy of the treatment undertaken at the Clinic of Internal Diseases, Faculty of Veterinary Medicine, University of Zagreb.

Materials and methods

The study included 42 horses diagnosed with tetanus and treated at the Clinic of Internal Diseases, Faculty of Veterinary Medicine, University of Zagreb, during the 1990-2009 period. The diagnosis of tetanus was based on the history and characteristic clinical signs (RADOSTITS et al., 2007).

None of the affected horses had received any tetanus vaccinations.

According to breeds, there were 34 coldblood and 8 warmblood horses. There were 15 male (6 colts, 4 stallions and 5 geldings and 27 female horses (3 foals, 6 fillies and 18 mares). The youngest and oldest animals affected were aged one month and 20 years, respectively. The mean age of all study animals was 5.8 years.

Visible injuries considered to be likely infection were distributed over the horses' bodies in five main areas. The distribution of these areas was based on the classification and presentation of the horse body regions according to POPESKO (1980), as follows: head, neck, chest, abdomen, and extremities.

Incubation was determined in the affected horses when the time of injury was known.

The main parameter for data comparison and processing was disease outcome, i.e. the number of surviving and non-surviving animals. The effect on disease outcome was assessed for the following parameters: horse breed (coldblood/warmblood); gender (male/female); age; presence and localization of wounds; presence of particular clinical signs; medical therapy options; and length of treatment. Medical therapy options included animals treated with benzylpeniciln, animals not treated with antibiotics and neuroleptic therapy or a combination of neuroleptics and myorelaxants.

The horses were maintained in slings very similar to a Liftex®, Inc. sling, in darkened boxes.

Procaine benzylpenicillin (Benzapen®, Veterina d.o.o., Zagreb, Croatia), was administered to 34 horses, at a dose of 22,000 IU/kg intra muscularly (IM) (SAKAR and SAKAR, 1999). Six horses did not receive any antibiotic therapy.

Tetanus antiserum (TAT) was administered on the day of presentation at the clinic or previously by the local veterinarian. Free toxin neutralization was achieved by TAT (Tetanus-Antitoksin 300®, Pliva d.d., Zagreb, Croatia) from the group of immunosera, at a therapeutic dose of 50.000 IU intravenously (IV) in adult horses and 20.000 IU in foals. Phenothiazine neuroleptics and myorelaxants were used for muscle spasm control. Propionylpromazine (Combelen®, Bayer AG, Leverkusen, Germany), at a dose of 0.06-0.1 mg/kg body mass, was used until 2005 (SAKAR and SAKAR, 1999). Since 2005, a combination of acepromazine (Sedalin®, Chassot & Cie AG, Belp-Bern, Switzerland) and diazepam (Diazepam®, Alkaloid AD, Skopje, Macedonia) has been used. The dose

of acepromazine was 0.02-0.1 mg/kg IM body mass, and of diazepam 0.1-0.2 mg/kg IV body mass.

The Statistica 8.0 (STATSOFT, Tulsa, USA) software was used for data processing and analysis. Results were considered significant at the level of $P<0.05$. The correlation and statistical significance of the effect of the study parameters on disease outcome were assessed by the χ^2-test.

Results

During the 1990-2009 period, 42 cases of tetanus were diagnosed at the Clinic of Internal Diseases, Faculty of Veterinary Medicine, University of Zagreb. Nineteen (45.2 %) of 42 horses died, including 15 (78.9 %) coldblood and 4 (21.1 %) warmblood horses, or, according to gender, 7 (36.8 %) male and 12 (63.2 %) female horses (Table 1). There was no statistically significant effect of animal horse breed or gender on disease outcome. Four (9.8 %) treated animals aged below 1 year were treated and one of them did not survive. Out of 19 (46.3 %) animals aged 1-7 years, 9 (47.4 %) animals died in spite of treatment. Eight of 18 (43.9 %) horses aged less than 7 died. There was no statistically significant age difference according to disease outcome. The age of one horse that died remained unknown.

Table 1. Relation between gender, breed and the survival rate in 42 horses suffering from tetanus

	Coldblood horses			Warmblood horses			Total		
	All	Male	Female	All	Male	Female	All	Male	Female
Total (%)	34 (81 %)	12 (35.3 %)	22 (64.7 %)	8 (19 %)	3 (37.5 %)	5 (62.5 %)	42 (100 %)	15 (35.7 %)	27 (64.3 %)
Non-survivors (%)	15 (44.1 %)	6 (50 %)	9 (40.9 %)	4 (50 %)	1 (33.3 %)	3 (60 %)	19 (45.2 %)	7 (46.7 %)	12 (44.4 %)
Survivors (%)	19 (55.9 %)	6 (50 %)	13 (59.1 %)	4 (50 %)	2 (66.7 %)	2 (40 %)	23 (54.8 %)	8 (53.8 %)	15 (55.6 %)

Visible injuries were found in 24 (57.1 %) horses. The presence of an obvious wound was found to have a statistically significant effect on disease outcome (Table 2). The most common localization of the wound was on the head and neck (29.1 % both), followed by the extremities (25 %). However the anatomic location of the injury had no statistically significant effect on the outcome.

Table 2. Relation between wound presence and survival rate in 42 horses suffering from tetanus

Presence of wound	Non-survivors (%)	Survivors (%)	Total (%)
Yes	14 (58.3 %)	10 (41.7 %)	24 (57.1 %)
No	5 (27.8 %)	13 (72.2 %)	18 (42.9 %)

There was no statistically significant difference in the disease outcome according to the length of incubation in injured animals, i.e. the period between injury and the development of clinical signs of disease.

The most common clinical signs were limb spasms (100 %), trismus (95.2 %), and nictitating membrane prolapse (71.4 %). A statistically significant increase in mortality was related to recumbency and sudoresis. Otherwise there was no statistically significant difference in disease outcome according to other clinical signs (Table 3).

No statistically significant difference in disease outcome was determined between the group of animals treated with procaine benzylpenicillin and the group of animals not receiving antibiotics.

Fifteen (44.1 %) of 34 horses treated with a phenothiazine derivative did not survive. Eight horses were treated with a combination of acepromazine and diazepam, and 4 (50 %) of them did not survive. There was no statistically significant difference in disease outcome according to therapeutic option applied.

Table 3. The frequency of clinical signs and disease outcome in 42 horses suffering from tetanus

	Total (%)	Non-survivors (%)	Survivors (%)
Extremity spasm	42 (100 %)	19 (45.2 %)[a]	23 (54.7 %)[a]
Trismus	40 (95.2 %)	19 (47.5 %)[a]	21 (52.5 %)[a]
Third eyelid protrusion	30 (71.4 %)	14 (46.6 %)[a]	16 (53.3 %)[a]
Hypersensibility	18 (42.8 %)	8 (44.4 %)[a]	10 (55.5 %)[a]
Head and neck spasm	15 (35.7 %)	8 (53.3 %)[a]	7 (46.6. %)[a]
Tail spasm	15 (35.7 %)	8 (53.3 %)[a]	7 (46.6 %)[a]
Ears spasm	12 (28.5 %)	6 (50 %)[a]	6 (50 %)[a]
Nostril spasm	12 (28.5 %)	6 (50 %)[a]	6 (50 %)[a]
Profuse sweating	9 (21.4 %)	7 (77.8 %)[a]	2 (22.2 %)[b]
Recumbency	7 (16.7 %)	7 (100 %)[a]	-[b]

[a,b] Results between the rows with different exponents are statistically significantly different ($P<0.05$).

In this study the overall mortality was 45.2 %. The majority of lethal outcomes (n = 15; 79 %) were recorded in the first seven days of treatment, whereas only 4 (21 %) horses died after a longer period of treatment, yielding a statistically significant difference according to the length of treatment. The mean length of treatment in recovered animals was 26 days.

Discussion

Tetanus is still associated with a high mortality rate, ranging from 58 % to 80 % in equidae (GREEN et al., 1994; VÖRÖS et al., 1997; SMITH, 2002; VAN GALEN et al., 2008; REICHMANN et al., 2008). The mortality of 45.2 % recorded in the present study was lower than that reported in previous studies. In spite of accommodation in slings in dark boxes and 24-hour intensive care, tetanus mortality in horses is still much higher than in dogs, where mortality is considerably lower (7.7 %-23 %) (ADAMANTOS and BOAG, 2007; BURKITT et al., 2007). This difference in mortality between horses and dogs is possibly explained by the high sensitivity of equine species to the effect of tetanus toxins, and difficulties in handling and nursing large animals suffering from the disease (VAN GALEN et al., 2008).

In our study, there was no statistically significant difference in disease outcome according to the horse breed, which is consistent with the study by MALIKIDES et al. (2002). We did not find a statistically significant gender difference in disease outcome, and this again is consistent with previous reports (MALIKIDES et al., 2002; VAN GALEN et al., 2008). The outcome was not significantly influenced by the age of the treated horses, which is consistent with other literature reports (MALIKIDES et al., 2002; REICHMANN et al., 2008). GREEN et al. (1994) suggested an age predisposition for younger horses, but did not report an association between age and survival, while VAN GALEN (2008) in a retrospective study of 31 cases, suggested that young horses are particularly vulnerable to tetanus, and their prognosis is poorer than that of older horses.

The diagnosis of tetanus was based on a thorough history and characteristic clinical signs. Similar to the results reported by VAN GALEN et al. (2008), skin injury was found in 57 % of affected horses. Irrespective of the statistically significant difference in disease outcome according to the presence of a wound, the prognostic value of this parameter should be critically evaluated because the site of infection entry is usually difficult to identify in horses, due to their long haircoat, while minor wounds frequently favor the development of anaerobic conditions for the growth of *C. tetani*.

In our study, the majority of injuries were found on the head and neck, in contrast to some literature reports on the wounds detected in tetanus affected horses being localized on the extremities (GREEN et al., 1994; REICHMANN et al., 2008). Our results could

probably be explained as being consequential to inappropriate horse care, along with the work and training methods applied to the horses. More attention should also be paid to the prompt surgical treatment of all types of injuries in order to prevent development of favorable conditions for the growth of tetanus agents.

Investigating the effect of the length of incubation on disease outcome in the animals with visible injuries and known time of injury infliction failed to show better outcome in the animals with disease incubation of more than 7 days, which is consistent with other literature reports (JOHNSTON, 1987; SMITH, 2002; MacKAY, 2007; REICHMANN et al., 2008; VAN GALEN et al., 2008). However, our results should be interpreted with caution because the time of incubation was only known in 13 affected horses.

Limb spasms, trismus and nictitating membrane prolapse were the most common clinical signs, which is consistent with the results reported by REICHMANN et al. (2008). All of the 7 horses that became recumbent died, confirming the statement of RADOSTITS et al. (2007) that lying down is associated with poor prognosis. Sudoresis was recorded in 9 affected horses, resulting in 77.7 % mortality. Profuse sweating as a clinical sign correlated significantly with disease outcome, which is in agreement with the finding reported by CVETNIĆ (2002) that sudoresis is indicative of poor prognosis and occurs in the terminal stage of the disease, when the animal has become recumbent, which is accompanied by even more severe muscle spasms.

In the present study, the majority of tetanus affected horses died within the first 7 days of the onset of clinical signs, identifying the first week of the disease as a critical period for survival (REICHMANN et al., 2008; VAN GALEN et al., 2008).

Similar to the study reported by REICHMANN et al. (2008), our data showed no statistically significant difference in disease outcome in relation to the use of antibiotics. Neither was there any statistically significant difference in disease outcome according to the use of neuroleptics, confirming the results reported by FORENBACHER (1967).

The mean length of treatment in recovered animals was 26 days, which is in agreement with the mean length of treatment of tetanus-affected horses reported in the literature (CVETNIĆ, 2002; VAN GALEN et al., 2008). Recent studies in horses suffering from generalized tetanus point to the successful adjuvant physiotherapy adapted from the therapy used for humans (MYKKÄNEN et al., 2011).

Considering the high mortality rate in tetanus affected horses despite the administration of tetanus antitoxin, antibiotics, neuroleptics, the specific hospitalization conditions (dark, isolated boxes) and care, there is an obvious need for additional education of horse owners, with special reference to keeping and working conditions, wound treatment, recognition of the initial clinical symptoms of the disease, and the favorable effect of tetanus vaccination.

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SAŽETAK

U radu su prikazani klinički znakovi i liječenje 42 konja oboljela od tetanusa, zaprimljena na Klinici za unutarnje bolesti Veterinarskog fakulteta Sveučilišta u Zagrebu u razdoblju od 1990. do 2009. godine. Od toga broja, 34 je bilo hladnokrvnjaka, a 8 toplokrvnjaka. Najčešći klinički znakovi bili su ukočenost mišićja udova, trizam i prominiranje treće očne vjeđe. Uginulo je 45,3 % životinja, a prosječna dob oboljelih konja bila je 5,8 godina. Utvrđeno je da je prvih 7 dana bolesti najkritičnije razdoblje za preživljavanje. Brža progresija kliničkih znakova, nemogućnost ustajanja, kao i profuzno znojenje upućuju na nepovoljnu prognozu bolesti.

Ključne riječi: konj, tetanus, retrospektivno istraživanje