

RHODOCOCCUS EQUI INFECTIONS OF PERSONS WITH AND WITHOUT A CONTACT WITH ANIMALS

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Abstract

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The analysis of 115 reports on *R. equi* infection in man showed that only 59 (51 %) contained data on the possible exposure to animals, manure or soil. The positive contact was reported in 35 cases (30 %) and denied in 24 cases (21 %). The most common type of contact was the exposure to horses or horse manure, being mentioned in 18 cases. The next most frequent type of exposure was farming. In the animal exposure positive group the median age was 30 years, male to female ratio (M:F) was 3.38 and the clinical outcome was fatal in 10 cases out of 35 (29 %). In the group of patient without the animal exposure the median age was 39 years, M:F was 3.0 and the outcome was fatal in 11 cases out of 24 (46 %). The differences were not significant. There was also no difference in the presence of HIV infection between patients with and without the animal exposure, HIV infection being reported in 16 out of 35 patients with the positive animal exposure and in 12 out of 24 of patients without such exposure. It is concluded that with a better epidemiological history the true percentage of *R. equi* infected persons with positive animal exposure may be higher.

Rhodococcus equi, infections of man, contact with animals, manure or soil

Rhodococcus equi (Magnusson) Goodfellow and Alderson 1977, formerly named *Corynebacterium equi*, has been for a long time considered a zoopathogenic microbe, mainly an agent of pneumonia in young equidae, mostly in foals (Prescott 1991). Since 1967, infections in humans, usually pneumonias or lung abscesses, have been reported (Golub et al. 1967). Immunodeficient persons, e.g. patients under cytotoxic therapy for malignancies, under immunosuppression after renal transplantation or alcoholics, are usually infected. After acquired immunodeficiency syndrome (AIDS) turned out, many cases of rhodococcal lung infections in human immunodeficiency virus (HIV) positive persons have been reported, the first one by Samies et al. (1986).

Though many reviews of human *R. equi* infections exist (the most recent e.g. McNeil and Brown 1994; Verville et al. 1994; Scott et al. 1995), none was aimed specifically at a possible contact of patients with animals. An analytical study from this point of view was made the topic of our paper.

Materials and Methods

MEDLINE data base was searched through using the terms „*Rhodococcus equi*“ and „*Corynebacterium equi*“ for relevant reports and references quoted in the reports were compared with our own collection of reprints. When the original source was not obtained, the data from reviews were employed (Doig et al. 1991; Drancourt et al. 1992; Harvey and Sunstrum 1991; Verville et al. 1995). Only reports concerning fully identified *R. equi* strains were considered.

We searched the text for data relative to the patient's contact with animals, esp. livestock, and with manure or soil. When the contact was not stated explicitly in the history of an individual case reported but its importance as a risk factor was mentioned by the author, such a report was considered for the purpose of this study as denying the contact of the respective patient.

Results

Out of the 115 reports of *R. equi* infection in man described till this time, only 59 (51 %) contained data on the possible exposure to animals, manure or soil. Fifty nine reports with such exposure, either positive or negative, were analysed in the present study. The positive contact was reported in 35 cases (30 %) and denied in 24 cases (21 %). The most common type of contact was the exposure to horses or horse manure, being mentioned in 18 cases. Farming or working on farm was reported in 5 cases, cleaning cattle stalls in 2 cases. Once a contact with sheep was reported, once with a dog only and three times an exposure to livestock or farm animals was noted. Unspecified rural exposure or living in farm was mentioned in 3 cases. Few times the exposure was only tacit one, e.g. study of a school of agriculture (Egawa et al. 1990), being a strict vegetarian (Walsh and Cunha 1994) or frequent walking barefoot when travelling through India (Antinori et al. 1992), the last in a patient with a lesion on the sole of her foot. Detailed description of the possible animal contact together with age, sex, HIV infection status and clinical outcome data of patients are given in the Table 1.

Table 1
R. equi infections in humans having positive contact with animals, manure or soil

No	Age	Sex	HIV	Out- come	Description of the contact	(References)
1.	29	M	-	R	Worked in the stockyards...cleaned out pens that had housed cattle, sheep, and swine	(Golub et al. 1967)
2.	1	M	-	R	Living in farm, sucking on carrots from a garden with soil contaminated by the organism	(Verville et al., 1994)
3.	39	M	-	D	Owned four horses and at a country fair was exposed to a large number of animals	(Marsh & von Graevenitz 1973)
4.	26	M	-	R	Exposure to farm animals	(Doig et al. 1991)
5.	47	F	-	R	Lived next to a field where horses had grazed... was fond of outdoor gardening and used dried cow's manure as a fertilizer	(Berg et al. 1977)
6.	45	F	-	D	Farmer	(Doig et al. 1991)
7.	30	M	-	R	Milked dairy cattle and cleaned their stalls	(van Etta et al. 1983)
8.	69	M	-	R	Cared for livestock and domestic animals	(MacGregor et al. 1986)
9.		M	+	R	Worked as an animal and horse handler	(Wang et al. 1986)
10.	51	F	-	R	Farmer	(Doig et al. 1991)
11.	45	M	+	D	Rural exposure	(Doig et al. 1991)
12.	29	M	+	R	Ranch work	(Doig et al. 1991)
13.	6	F	-	R	Visited a sheep farm twice in the 3 months preceding her admission	(Allen et al. 1989)
14.	28	M	+	R	Worked in a farm	(Flepp et al. 1989)
15.	53	M	-	D	Rural exposure - horse farm	(Doig et al. 1991)
16.	28	M	-	R	A student at a graduate school of agriculture	(Egawa et al. 1990)
17.	25	M	+	R	Horse trainer	(Kwon & Colby 1994)
18.	26	M	+	R	Exposed to several horses at a country fair	(Doig et al. 1991)
19.	30	M	+	D	Worked closely with Arabian horses	(Emmons et al. 1991)

20.	29	M	+	R	Worked as a grocer...recalled having petted horses a month before his symptoms began	(Lasky et al. 1991)
21.	25	M	+	R	Grew up on a horse farm...had been exposed to livestock	(Obana et al. 1991)
22.	32	M	+	R	Worked as a groom	(Rouquet et al. 1991)
23.	33	M	+	R	Worked as a gardener...had only little contact with horses and ponies	(Vestbo et al. 1991)
24.	25	F	+	R	Travelled through India, frequently walking barefoot	(Antinori et al. 1992)
25.	27	M	+	R	Close contact with horses	(Drancourt et al. 1992)
26.	22	M	+	D	Worked on a farm	(Gray 1992)
27.	35	M	-	R	Visited a sheep farm...had a source of exposure to domestic horses	(Sladek & Frame 1993)
28.	3	F	-	R	Dog (striking similarities to the ref. No 2)	(Verville et al. 1994)
29.	18	M	+	D	Exposure to horses	(Verville et al. 1994)
30.	53	M	-	R	Exposure to livestock	(Verville et al. 1994)
31.	31	M	+	D	Exposure to horses	(Verville et al. 1994)
32.	83	F	-	D	Strict vegetarian	(Walsh & Cunha 1994)
33.	65	M	-	R	An avid gardener ... used horse manure as fertilizer	(Adal et al. 1995)
34.	76	F	-	R	Horse breeder	(Bouchou et al. 1995)
35.	60	M	-	D	Owned two ponies	(Stolk-Engelaar 1995)

Legend: M = male; F = female; + = HIV infected; - = HIV non-infected; R = recovered; D = died

The analysed group of 59 patients included 45 males (76 %) and 14 females, the male to female ratio (M:F) being 3.21. In the positive animal exposure group there were 27 males (77 %, M:F 3.38), in the negative animal exposure group 18 males (75 %, M:F 3.0; $p > 0.05$).

The age of the persons with the positive animal exposure ranged from 1 to 83 years with the median of 30 years and the mean of 36.0 years, the age of individuals without the animal contact ranged from 3 to 66 years with the median of 39 years and the mean of 36.8 years ($p > 0.05$).

HIV infection was present in 28 persons altogether, viz. in 16 out of 35 with the positive animal exposure (46 %) and in 12 out of 24 without it (50 %; $p > 0.05$).

The clinical outcome was fatal in 21 cases, in 10 out of 35 (29 %) with the positive animal exposure and in 11 out of 24 (46 %) without it. The difference was not statistically significant ($p > 0.05$). The summary of results is given in Table 2.

Table 2
Summary of results concerning age, sex, HIV infection status and clinical outcome in *R. equi* infected patients with and without a contact with animals

Animal and/or soil exposure	Mean age (years)	Median age (years)	Male to female ratio	HIV+ (%)	Lethality (%)
positive (n=35)	36.0	30	3.38	46	29
negative (n=24)	36.75	39	3.00	50	46

Discussion

R. equi strains were isolated from soil from sites with variable land uses. They were found in faeces and dung pats of cattle, horses, sheep, pigs and goats but it seems that

their presence in the gut of herbivores is transient and depends upon ingestion of pasture or feedstuffs contaminated with this organism. Being an aerobe, little or no multiplication of *R. equi* occurs in the gut, voided dung providing a more favourable environment for its multiplication outside the animal host (Barton and Hughes 1984, Prescott 1991).

Hughes and Sulaiman (1987) reported that *R. equi* grew substantially better in soils enriched with faeces than in soils alone. Simple organic acids in horse dung, especially acetate and propionate, appear to support growth of *R. equi* in the environment.

R. equi has been isolated also from the manure of a high proportion of wild birds but it is uncommonly present in the manure of chicken. The organism appears rare in the faeces of dogs and so far has not been isolated from cats (Prescott 1991).

Thus, exposure to soil contaminated with herbivore manure is likely the major route of both animal and human infection. Contact with farm animals, manure or soil was reported in 35 (30 %) of all cases of *R. equi* infection in man and denied in 24 cases (21 %). Considering that this epidemiologic information was missing in 56 out of 115 reports (49 %), the true percentage may be even higher. The same conclusion was reached by Verville et al. (1994). The presentation of *R. equi* infections as pneumonia or as a disease associated with the gastrointestinal tract without pulmonary involvement suggests that humans and animals can acquire infection by either inhalation or ingestion of contaminated material. Human and animal infection can be also acquired by traumatic inoculation or superinfection of wounds (Verville et al. 1994).

In the first review of *R. equi* infection in patients with and without HIV infection Harvey and Sunstrum (1991) noted that a history of exposure to farm animals or manure was reported in 9 of the 20 cases in patients without HIV infection, such a history was reported for only two of 11 HIV infected patients. The difference between the two groups of patients was probably accidental because the further reports on *R. equi* infection in HIV positive persons brought the difference almost to zero. Our analysis of 51 papers with either confirmed or denied exposure to animals or soil showed the positive contact in 16 of 23 HIV infected cases (70 %) and in 20 of 28 HIV negative cases (71 %).

An insignificant age difference was apparent, most of persons with the positive exposure to animals being somewhat younger. Their median age was 30 years in comparison with the median age of patients without the animal contact which was 39 years. Mean age was almost identical in both groups (36.0 versus 36.8 years; $p > 0.05$).

The male:female ratio in the positive animal exposure group was almost the same as in the negative animal exposure group (3.38 in the former versus 3.0 in the latter). Generally, predominance of *R. equi* infection in males was partly explained by cases of HIV infected men, slight predominance of *R. equi* infection in males with the positive animal exposure was probably given by the difference in men's occupation. No author has yet noted the differences in age and male:female ratio mentioned above.

In the animal exposure negative group the fatal clinical outcome was higher, there were reported in 24 cases (46 %) with denied animal contact whereas in 35 patients with the positive animal contact the clinical outcome was fatal in 10 cases (29 %). Nevertheless, the difference was not statistically significant.

It is a pity that about one half of 115 reports on *R. equi* infection in man did not mention the possible exposure to animals, manure or soil. The contact was noted in 35 cases (30 %) and denied in 24 cases (21 %). It is probable that with a more thorough history of individual cases the true percentage may be higher.

Infekce vyvolané druhem *Rhodococcus equi* u člověka se zřetelem na možný kontakt infikovaných osob se zvířaty

Analýza 115 zpráv popisujících infekci druhem *R. equi* u člověka ukázala, že pouze 59 z nich (51 %) obsahovalo údaje o případné expozici vůči zvířatům, hnoji nebo půdě. Pozitivní kontakt byl zaznamenán v 35 případech (31 %) a popřen ve 24 případech (21 %). Nejběžnějším typem kontaktu byla expozice vůči koním nebo koňskému hnoji, zmínka o ní se vyskytla v 18 případech. Dalším nejčastějším typem expozice byla práce v zemědělství. Ve skupině exponovaných vůči zvířatům byl střední věk 31 let, poměr muži:ženy 3,38 a fatální vyústění choroby v 10 případech z 35 (26 %). Ve skupině pacientů bez expozice vůči zvířatům byl střední věk 39 let, poměr muži:ženy 3,0 a k úmrtí došlo v 11 případech z 24 (46 %). Tyto rozdíly nebyly významné. Co se týká přítomnosti infekce HIV, rovněž nebyl rozdíl mezi nemocnými s expozicí vůči zvířatům a bez ní; infekce HIV byla popsána u 16 z 35 pacientů exponovaných vůči zvířatům a u 12 z 24 pacientů neexponovaných. Lze uzavřít, že podrobnější epidemiologická data by pravděpodobně odhalila daleko vyšší procento osob infikovaných *R. equi* s pozitivní historií kontaktu se zvířaty.

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