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Comparison of Tolerance to Theileriosis in Different Breed of Cattle by Evaluation of Clinical Signs and Response to Treatment

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Abstract

BACKGROUND: Theileriosis is an important disease of cattle in Iran that could cause economic loss by reducing production and death. The disease in endemic areas would be mild or subclinical in indigenous cattle and clinically acute in exotics.

OBJECTIVES: This study was conducted to evaluate the resistance of indigenous cattle in comparison with Holstein and crossbred cattle against *Theileria annulata* through assessment of clinical signs and response to treatment.

METHODS: For this purpose, the data history and clinical examination were observed on 51 naturally affected cattle with *T. annulata* (17 Holstein, 17 crossbred and 17 indigenous cows). Examination of blood smears was used for diagnosis. Detection of schizonts in lymph node punctured smears confirmed validity of the suspect samples. All three groups of cows were treated with buparvaquone along with oxytetracycline. Their clinical signs and the results of blood smear examinations were recorded before and 48 hours after treatment. The severity of clinical signs, parasitemia rates and response to treatment were compared among the groups.

RESULTS: The results showed significant difference ($P<0.05$) in severity of fever, intense and abnormal lung sounds, mucosal changes (pallor, jaundice, petechiae) and ruminal hypomotility among the groups. There was no significant difference in parasitemia rate and response to treatment among the groups.

CONCLUSIONS: This study indicated that Iranian indigenous cattle in comparison with Holsteins and crossbreeds had milder clinical manifestations and no significant difference in response to treatment for tropical theileriosis.

KEYWORDS: Breed, Cattle, Clinical signs, Response to treatment, Theileriosis

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Introduction

Tropical theileriosis or Mediterranean Coast Fever - caused by *Theileria annulata* - *is* a disease of cattle widely distributed across Southern Europe, North Africa and Central Asia. Economically, theileriosis due to *T. annulata* is one of the most important diseases of cattle in Iran, with a major potential threat to expansion and improvement of livestock production (Hashemi-Fesharaki, 1988).

The disease and its severity not only depend on the virulence of the causative agent, but also to a large extent on the degree of host susceptibility, which largely depends on the breed (Osman and AlGaabary, 2007). In a stable endemic situation, there may be only mild or no clinical disease in local Zebu cattle (Constable *et al*., 2017). Clinical signs include marked fever, swelling of superficial lymph nodes, inappetence, tachycardia, dyspnea, anemia, pale mucous membranes, and icterus. Petechiae and ecchymoses may be found on the conjunctiva and oral mucous membranes. Other clinical signs are diarrhea, weight loss, with decreased milk yield (Constable *et al*., 2017). Exotic cattle (*Bos taurus*) are particularly susceptible with mortalities up to 40% to 80% in some areas, whereas in indigenous cattle (*Bos indicus*) that generally suffer from much lower mortalities (about 10%) it is confined mainly to calves (Hashemi-Fesharaki, 1988).

Theileriosis can be diagnosed by finding piroplasms in erythrocytes in Giemsa-stained thin smears from blood or lymph node biopsies showing schizonts in lymphocytes. Buparvaquone is the most effective agent available, and the recommended dose is 2.5 mg/kg BW (Constable *et al*., 2017). In Iran, the routine treatment method for theileriosis is using buparvaquone along with oxytetracycline, and control of disease relies on tick control using acaricides and theileriosis vaccination.

It is suggested that Iranian indigenous cattle in comparison with Holsteins had lower parasitemia rate, weaker response to *T. annulata* infection, milder clinical manifestations and significantly lower levels of acute phase proteins (Nazifi *et al.*, 2010).

This study was conducted to evaluate the resistance of indigenous cattle in comparison with Holstein and crossbred cattle against *T. annulata* through assessment of clinical signs and response to routine treatment.

Materials and methods

This study was conducted in the north region of Iran (Gonbad-e-kavous township), where theileriosis due to *T. annulata* is prevalent. Historical data were collected and clinical examination was done on 51 naturally affected cattle with *Theileria annulata* (17 Holstein, 17 crossbred and 17 indigenous cows). Clinical examination included measuring temperature, heart rate, respiratory rate, auscultation of heart and lung, mucosal observation (for jaundice, pallor, hemorrhages) and palpation of prescapular, prefemoral and submandibular lymph nodes.

Examination of blood smears was used for diagnosis. Peripheral blood samples were taken from auricular veins and blood smears were stained by Giemsa staining. The slides were examined through light microscope, in which the piroplasmic forms of the parasite were detected. The samples were divided into three groups according to their parasitemia rates by the percentage of infected erythrocytes (<33%, 33-66% and >66%). Suspected samples were confirmed by lymph node puncture and Giemsa staining which determined *Theileria* schizont forms.

All the cows in the three groups were treated with buparvaquone (single injection

of 2.5 mg/kg bodyweight (BW), IM) along with oxytetracycline (10 mg/kg BW, IM, q 24 h for 3 days). Their clinical signs and the results of blood smear examinations were recorded before treatment and 48 h after treatment. The severity of clinical signs, parasitemia rates and responses to treatment were compared among groups. Data obtained from this survey were analyzed statistically by SPSS software using Chi-square and analysis of variance (ANOVA) tests and $P<0.05$ was considered to be significant.

Results

Clinical findings revealed that all the affected cows in three groups had increased respiratory rate, 98% with anorexia and lymph nodes enlargement, 96.1% had fever and decreased milk yield. These clinical signs are more prevalent than others. In the indigenous cows the severity of fever was significantly ($P<0.05$) lower and the mean value of respiratory rate was significantly ($P<0.001$) lower than the other two groups. Abnormal lung sounds were only observed in Holstein cows (17.6%). Mucosal jaundice and petechiae were not seen in indigenous cattle and significant difference ($P<0.05$) in mucosal changes was recorded among groups. Ruminal hypomotility was significantly ($P<0.05$) lower in indigenous cattle (Table 1).

Table 1. The definite and relative frequencies of clinical signs of theileriosis according to breed of cattle

Clinical signs	Breed			
	Holstein Fr (%)	Crossbred Fr (%)	Indigenous Fr (%)	Total Fr (%)
Fever	16 (94.2)	17 (100)	16 (94.2)	49 (96.1)
Tachycardia	9 (52.9)	13 (76.4)	8 (47.1)	30 (58.9)
Increased respiratory rate	17 (100)	17 (100)	17 (100)	51 (100)
Increased heart sound intensity	7 (41.2)	6 (35.3)	2 (11.8)	15 (29.4)
Increased lung sound intensity*	8 (47.1)	3 (17.6)	0 (0)	11 (21.6)
Abnormal lung sounds*	3 (17.6)	0 (0)	0 (0)	3 (5.9)
Cough	13 (76.5)	9 (52.9)	9 (52.9)	31 (60.8)
Mucosal pallor*	10 (58.8)	7 (41.2)	3 (17.6)	20 (39.2)
Mucosal jaundice*	9 (52.9)	3 (17.6)	0 (0)	12 (23.5)
Mucosal petechiae*	6 (35.3)	3 (17.6)	0 (0)	9 (17.6)
Ruminal hypomotility*	14 (82.4)	15 (88.2)	9 (52.9)	38 (74.5)
Anorexia	17 (100)	17 (100)	16 (94.1)	50 (98)
Diarrhea	9 (52.9)	8 (47.1)	8 (47.1)	25 (49)
Lymph nodes enlargement	17 (100)	17 (100)	16 (94.1)	50 (98)
Teeth grinding (pain)	13 (76.5)	12 (70.6)	13 (76.5)	38 (74.5)
Decreased milk yield	17 (100)	17 (100)	15 (88.2)	49 (96.1)

Fr (%) frequency, * $P<0.05$

In the present study the parasitemia rate was quantified and expressed as the percentage of infected erythrocytes. The difference in the percentage of infected erythrocytes was not significant among groups (Table 2). This finding indicated that parasitemia rate was not different in three breeds of cows.

Table 2. The percentage of infected erythrocytes according to breed of cattle

Infected erythrocytes (%)	Breed			
	Holstein Fr (%)	Crossbred Fr (%)	Indigenous Fr (%)	Total Fr (%)
< 33	3 (17.6)	7 (41.2)	5 (29.4)	15 (29.4)
33-66	6 (35.3)	3 (17.6)	5 (29.4)	14 (27.5)
> 66	8 (47.1)	7 (41.2)	7 (41.2)	22 (43.1)

Fr (%) frequency, α=0.05

There was no significant difference among the breeds in response to treatment with buparvaquone along with oxytetracycline (Table 3). The data history of animals showed that delay in treatment is a notable factor in response to treatment, in addition severity of parasitemia decreased the effects of the treatment.

Table 3. The response to treatment of theileriosis according to breed of cattle

Response to treatment	Breed			
	Holstein Fr (%)	Crossbred Fr (%)	Indigenous Fr (%)	Total Fr (%)
Positive	11 (64.7)	11 (64.7)	9 (52.9)	31 (60.8)
Negative	6 (35.3)	6 (35.3)	8 (47.1)	20 (39.2)

Fr (%) frequency, α=0.05

Discussion

Tropical theileriosis is an important parasitic disease of cattle in Iran with a potentially great economic impact. Local breeds have tolerance to infection while exotic and cross breeds are highly susceptible to great loss due to progression of this disease (Hashemi-Fesharaki, 1988). In this study Holstein and crossbred cows showed higher (P<0.05) fever than indigenous cows. The mean value of respiratory rate in the indigenous cows was significantly (P<0.001) lower than the other two groups and abnormal lung sounds were only observed in Holstein cows. The frequencies of mucosal pallor, jaundice and petechiae were higher (P<0.05) in Holstein cows. Ruminal hypomotility was significantly (P<0.05) lower in indigenous cattle. These results suggested that Holstein and crossbred cattle suffer more acutely from the disease than indigenous cattle that are more resistant to theileriosis and exhibit milder clinical signs. The different response of various cattle breeds has been investigated in *Theileria*

infections. In breeds of cattle such as *Bos indicus*, Sahiwal is more resistant to *T. annulata*. This breed exhibited mild clinical signs and recovered from a dose of parasite which was fatal in the Holstein, *B. Taurus*. Holsteins showed higher fever response and higher levels of parasitemia rate than Sahiwals. One feature of theileriosis is the production of acute phase proteins indicating that the parasite induces high systemic levels of pro-inflammatory cytokines. In Holsteins, there is prolonged production of the acute phase proteins, which in contrast is only slightly elevated in the Sahiwals (Glass and Jensen, 2007). Nazifi *et al*. (2010) reported that Iranian indigenous cattle compared with Holsteins had lower parasitemia rate, weaker response to *T. annulata* infection, milder clinical manifestations and significantly lower levels of acute phase proteins. Schizont-infected cells multiply in the draining lymph nodes and disseminate rapidly along with lymphoblasts throughout the lymphoid tissues and in nonlymphoid organs, including the liver, kidney, lung, abomasum, and brain. Virulence of the disease is associated with the capacity of infected cells to disseminate inside the host. Later, schizonts differentiate into merozoites and invade erythrocytes (as piroplasms). The pathogenesis therefore involves proliferation of macrophages induced by schizonts, and anemia with icterus induced mostly by the piroplasms. Macrophages/monocytes are the main producers of inflammatory cytokines that can induce an acute-phase protein response. The response is greater in *Bos taurus* Holstein breed than the *Bos indicus* Sahiwal breed, and this would explain the greater severity of disease in the Holstein. Infected macrophages from taurine breeds are also more capable of aggressive invasiveness than zebu breeds (Constable *et al*., 2017).

In East and Southern Africa, Zebu and Sanga cattle and their crossbreds are considered to be tolerant to theileriosis (Ndung'u *et al*., 2005). Resistance to tick infestation varies among breeds of cattle. It is known that in many subtropical environments in Africa, indigenous breeds are highly resistant to ticks and theileriosis (Laisser *et al*., 2017). This study showed no parasitemia rate difference among the three breeds of cows.

The ability of cattle to resist ticks and tick-borne diseases such as theileriosis depends on the strength of their immunity to respond against the infectious sporozoites, schizonts, and piroplasm parasitic antigens. Development of a stronger immunity system comes about through exposure to such diseases (Laisser *et al*., 2017).

In this study there was no significant difference among the breeds in response to treatment with buparvaquone along with oxytetracycline. History of animals indicated that treatment is most effective in the early stages of the disease and delay in treatment would have a notable impact on the animals' response to the treatment. In addition, severity of parasitemia decreased the effects of treatment. These findings were in agreement with what was previously described by Dhar *et al*. (1988) and McHardy *et al*. (1985).

Zebu cattle survive without regular tick control methods such as dipping or spraying and the infected animals recover without treatment, using drugs (Laisser *et al*., 2014; Kazungu *et al*., 2015). This indicates that the indigenous zebu cattle in Tanzania possess genes which enable them to live and reproduce under high tick and theileri-

osis challenges (Laisser *et al*., 2017).

Some factors that affect cattle to resist tick infection include heritability of the trait where cattle acquire the tolerability through inheritance, natural exposure to infected ticks, immunization by infection and treatment method, increasing tick challenge, and increased calf recovering rate after a disease challenge (Laisser *et a*l., 2017).

This study showed that Iranian indigenous cattle in comparison with Holsteins and crossbreds had milder clinical manifestations and no significant difference in response to treatment for tropical theileriosis.

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Conflict of interest

The authors declared that there is no conflict of interest.

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مجله طب دامی ایران، ۱۳۹۹، دوره ۱۴، شماره ۳، ۲۳۱-۲۳۸

مقایسه مقاومت نژادهای مختلف گاو نسبت به تیلریوز با ارزیابی نشانه های بالینی و پاسخ به درمان

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چکیده

زمینه مطالعه: تیلریوز یکی از بیماریهای مهم گاو در ایران است که باعث خسارات اقتصادی از طریق کاهش تولید و مرگ دام‌ها می‌شود. در نواحی اندمیک ممکن است این بیماری در گاوهای بومی به صورت خفیف و تحت بالینی ودر گاوهای غیربومی به شکل بالینی و حاد بروز یابد.

هدف: هدف این تحقیق ارزیابی مقاومت گاوهای بومی در مقایسه با گاوهای هلشتاین و دورگ در مقابل آلودگی با تیلریا آنولاتا از طریق بررسی نشانه های بالینی و پاسخ به درمان است.

روش کار: اخذ سابقه و معاینه بالینی روی ۵۱ رأس گاو مبتلا به تیلریوز (۱۷ رأس هلشتاین، ۱۷ راس دو رگ، ۱۷ رأس بومی) انجام شد. مبنای تشخیص بیماری بررسی گسترش خون و در موارد مشکوک یافتن شیزونت انگل در نمونه های بیوپسی عقده های لنفاوی بود. تمامی گاوها در سه گروه با تجویز بوپاراواکن همراه با اکسی تتراسیکلین تحت درمان قرار گرفتند. نشانه های بالینی و نتایج بررسی گسترش های خون قبل از شروع درمان و ۴۸ ساعت بعد از آن ثبت شد. شدت نشانه های بالینی، میزان پارازیتمی و پاسخ به درمان در سه گروه با هم مقایسه شد.

نتایج: مطالعه حاضر نشـــان داد که تفاوت‌های معنی داری ($P<۰/۰۵$) در شـــدت تب، شدت صداهای ریه، صداهای غیرطبیعی ریه، تغییر در مخاطات (کمرنگی، زردی، خونریزی‌های نقطه ای) و کاهش حرکات شکمبه در بین گروه ها وجود دارد. تفاوت معنی داری از نظر میزان پارازیتمی و پاسخ به درمان در بین گروه ها وجود نداشت.

نتیجه گیری نهایی: این تحقیق نشان داد که گاوهای بومی ایران در مقایسه با گاوهای هلشتاین و دو رگ نشانه های بالینی تیلریوز را به شکل خفیف تری بروز می‌دهند ولی تفاوت معنی‌داری از نظر پاسخ به درمان بین آنها وجود ندارد.

واژه‌های کلیدی:

نژاد، گاو، نشانه های بالینی، پاسخ به درمان، تیلریوز.

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