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Letter to the Editor

Occurence of hypodermosis in Pakistan, Iran and Turkey: comparative risk factor analysis and future perspectives

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Dear Editor,

Hypodermosis is one of the most serious veterinary health problems among all the parasitic infestations in the world. Among several restraining factors, parasitic infestations that severely affect the livestock sector are the biggest culprit in reducing the economic impact of hide industry. It is an endemic disease which is regularly observed in both wild and domestic ruminants (cattle and buffaloes) across the northern hemisphere [1]. It results in severe decrease in meat and milk production and reducing the hide quality, causes a great deal of economic loss in developing countries [2]. The present report shows the systemic pattern of hypodermosis in Pakistan [2-8], Iran [9-14] and Turkey [15-19] from 2000-2015. The data analysis showed that hypodermosis is highly prevalent in Pakistan followed by Iran and Turkey (Table 1).

There are different risk factors responsible for the presence of hypodermosis in Pakistan, Iran and Turkey. The potential risk factors are categorized into the following types; (a) Biological factors such as age, sex, breed, previous exposure and medication schedule (b) Physical factors such as grazing pattern, management practices, presence of waterbodies, sunshine, humidity, month, area, color, rainfall, precipitation, location and field/slaughter house [20,21]. The results showed that age, sex, breed, medication schedule, grazing pattern, area, month, previous exposure, management practices, presence of water bodies, temperature, precipitation and location are significant risk factors ($p < 0.05$) in Pakistan. Similarly, in Turkey (age, sex, breed, color and rainfall) while in Iran (age and sex) are among the significant risk factors ($p < 0.05$) in comparison with the other factors. In some studies it was reported that non-significant risk factors are in Pakistan (sex, breed, age, medication), Turkey (breed) while in Iran (sex) (Table 2).

In the last decade, the eradication programmes for the management and control of hypodermosis have been developed and many strategies were used in some countries. These strategies depend on the environmental conditions of that country e.g. insecticides in warble season. One of the major challenges in the eradication strategies is that hypodermosis is diagnosed at the last stage of its life cycle by using the traditional palpation method. The ELISA should be used for early diagnosis. So it will be the only possible way for early diagnosis and the eradication at the early phase of infestation, that is possible.

Control programs should be launched for the eradication of hypodermosis in Pakistan, Iran and Turkey. There is wide variation in the epidemiology of *Hypoderma* infestation in different areas of the world [22]. Due to some factors like (i) inefficient strategies for infection control (ii) re-introduction of the infection (iii) importation of infested cattle (iv) immigration of flies, there is very high chance of *Hypoderma* regeneration [23].The second-generation avermectin (like eprinomectin) belongs to the class of macrocyclic

lactone which can be used as insecticide. The endectocidal activity was recorded in a 0.5% formulation. It has been reported all over the world that it consists of natural oils for pour-on administration at 0.5 mg eprinomectin/kg body weight in laboratory and field investigations [24].There might be some recombinant vaccine that should be used to control the menace and to reduce the economic losses.

Recommendations

On the basis of the above mentioned facts, some guidelines are proposed according to local environmental factors and life style to help an optimal control program. These guidelines can be adjusted according to individualized risk assessment.

1. It is strongly recommended in the above mentioned countries to determine the intensity of disease and the livestock population at risk should be estimated. Due to poor immunity of these animals are under high risk of developing a disease *e.g.* WFI.
2. Antiparasitic drugs should be used to control of hypodermosis in Pakistan, Iran and Turkey. So there is dire need to implement the eradication strategies to control the disease.
3. There should be some training workshops for the livestock owners to train them for the protection of their cattle from the warble fly.
4. In "fly" season the regular monitoring by the livestock department regarding the infestation intensity is highly recommended. This will help to control the disease spread and ultimately in disease eradication.

Concerns and future perspectives

Recombinant vaccines development against many parasitic infestations is in progress. Efficacy results of these vaccines targets strongly suggests that most of these vaccines likely to become reality in near future. It is very important to control *Hypoderma* spp due to its economic significance. The initial concept

Table 1. Occurence of hypodermosis in Pakistan, Turkey and Iran

Country	Year	District	Hosts	Prevalance (%)	Species	References
Pakistan	2014	Toba Tak Singh	Buffalo	11.37	*H. bovis*	[6]
	2014	Blochistan	Goat	16.59	*P. silenus*	[7]
	2013	Chakwal	Goat	17.8	*P. silenus*	[8]
	2013	Norhern Punjab	Cattle	17.4	*H. lineatum*	[5]
	2013	Jehlum	Buffalo	3.2	*H. lineatum*	[21]
	2012	Norhern Punjab	Cattle	18.4	*H. lineatum*	[4]
	2006	D.G.Khan	Cattle Buffalo	29.5 5	*H. lineatum*	[2]
		RajanPur	Cattle Buffalo	26 4	*H. lineatum*	
	2002	D.G. Khan	Buffalo	0.036	*Hypoderma* spp.	[3]
Turkey	2011	Afyonkarahisar	Cattle	2.96	*H. lineatum*, *H. bovis*	[19]
	2010	Erzurum	Cattle	28.6	*H. lineatum*, *H. bovis*	[18]
	2008	Malatya Elazig Diyarbakir	Cattle	22.3 26.3 22.1	*Hypoderma* spp.	[17]
	2008	Nigde	Cattle	5.08	*Hypoderma* spp.	[16]
	2005	Kars	Cattle	31.9	*Hypoderma* spp.	[15]
	2000	Thrace	Cattle	3.56	*H. bovis*, *H. lineatum*	[27]
Iran	2014	Tabriz	Cattle	13.75	*H.bovis*	[28]
	2014	Khorasan	Goat	11.11	*P. silenus*	[14]
	2012	Afshan	Cattle	5	*H. lineatum*, *H. bovis*	[11]
	2012	Kerman	Goat	14.7	*P. silenus*	[12]
	2012	Shiraz	Goat	2.67	*P. silenus*	[13]
	2012	Kashan	Cattle	61.4 12.6	*H. lineatum* *H. bovis*	[10]
	2007	Southwestern Iran	Sheep Goat	0.2 5.3	*P. silenus*	[9]

Table 2. Comparative risk factors analysis of hypodermosis in Pakistan, Iran and Turkey.

Country	Year	District	Risk Factors																	References
			Biological								Physical									
			Age	Sex	Breed	Previous exposure	Medication	Month	Area /District	Color	Rain Fall	Humidity/Precıpitation	Sunshine	Temperature	Water bodies	Management practices	Location	Grazzing Pattern	Field/ Slaughter	
Pakistan	2015	Punjab	-	-	-	-	-	-	-	-	-	S	-	S	-	-	-	-	-	[29]
	2014	Toba Tak Singh	S	S	-	-	-	S	-	-	$	$	-	$	-	-	-	S	-	[6]
	2014	Blochistan	S	N.S	N.S	-	-	S	-	-	-	-	-	-	-	-	-	-	-	[7]
	2013	Chakwal / Khoshab	N.S	N.S	S	-	N.S	S	S	-	-	-	-	-	-	-	-	-	-	[8]
	2013	Jehlum	S	S	-	-	-	-	S	-	-	-	-	-	-	-	-	-	-	[5]
	2013	Norhern Punjab	S	S	S	S	S	S	S	-	-	-	-	-	S	S	S	S	-	[21]
	2012	Norhern Punjab	-	-	-	-	-	S	S	-	-	-	-	-	S	-	-	-	-	[4]
	2006	D.G. Khan	$	$	-	-	-	-	$	-	-	-	-	-	-	-	-	-	$	[2]
		RajanPur	$	$	-	-	-	-	$	-	-	-	-	-	-	-	-	-	$	
	2002	D. G. Khan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[3]
Turkey	2011	Afyonkarahisar	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	$	[19]
	2010	Erzurum	-	-	$	-	-	-	$	-	-	-	-	-	-	-	-	-	-	[18]
		Malatya	S	S	N.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2008	Elazig	S	S	N.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[17]
		Diyarbakir	S	S	N.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2008	Nigde	-	-	-	-	-	$	-	-	-	-	-	-	-	-	-	-	-	[16]
	2005	Kars	S	S	S	-	-	-	S	S	-	-	-	-	-	-	-	-	-	[15]
	2000	Thrace	-	-	-	-	-	$	-	-	-	-	-	-	-	-	$	-	-	[27]
Iran	2014	Tabriz	$	-	-	-	-	$	-	-	-	-	-	-	-	-	-	-	$	[28]
	2014	Khorasan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[14]
	2012	Afshan	-	-	-	-	-	$	-	-	-	-	-	-	-	-	-	-	-	[11]
	2012	Kerman	S	N.S	-	-	-	$	-	-	-	-	-	-	-	-	-	-	-	[12]
	2012	Shiraz	-	-	-	-	-	$	-	-	-	-	-	-	-	-	-	-	-	[13]
	2012	Kashan	$	N.S	-	-	-	$	-	-	-	-	-	-	-	-	-	-	-	[10]
	2007	Southwestern Iran	$	S	-	-	-	$	-	-	-	-	-	-	-	-	-	-	-	[9]

S:Significant difference; N.S: Non significant difference; $: The difference was present but statistical analysis was not performed; - : Factor not studied.

regarding *Hypoderma* spp. vaccines development was to use crude hypodermin proteins to induce adaptive immune response. Later on vaccine which was based on three enzymatic secretions (i.e. HyA, HyB and HyC). Among them HyA was used in its purified form [25]. HyA in combination with the adjuvant (alhydrogel/amphigen) was the main component of vaccine [26]. But these vaccination trials are not very successful in controlling of hypodermosis. These vaccine candidates were not ideal because it would be difficult to standardize a vaccine in field animals. Although some efforts were taken to overcome this limitation of the vaccine, but there are very few studies regarding the development of a vaccine candidate having higher efficacy, safety and long-term stability under field conditions. The future studies are highly warranted to develop recombinant vaccines/antibodies which meet the standard defined by WHO regarding vaccine purity, safety and efficacy.

Due to inconsistence risk factors analysis in these countries there is no conclusive evidence about any specific risk factor for hypodermosis. It is a need of hour to have a specific mapping of risk factors in near future. It is obligatory to contain the infection to avoid economic losses as all of these countries are agricultural countries.

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