Human dirofilariasis: an emerging zoonosis in India

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Abstract Human dirofilariasis is an uncommon zoonotic infection having a widespread geographical distribution. World over 800 cases of *Dirofilaria* are on record with highest numbers from Italy, Sri Lanka and republics of the ex-Soviet Union. *Dirofilaria repens* belongs to the subgenus *Nochtiella* and is the most common species identified in India. Topographically, the orbital/periorbital regions are the most common regions involved by *Dirofilaria*. We present a brief review of cases from India including two received in our own institute. This review focuses on the epidemiology of the disease including its geographical distribution and the probable causation of the recent increase in its incidence in Indian subcontinent.

Keywords *Dirofilaria* · *Dirofilaria repens* · Subcutaneous dirofilariasis · India · Epidemiology · Zoonosis

Introduction

Dirofilariasis is an uncommon zoonotic disease where man is the dead end host. Among nearly forty species of *Dirofilaria* identified, only a few give rise to human infection. There are

two forms of the disease—(a) pulmonary dirofilariasis caused primarily by *Dirofilaria immitis* (the dog heartworm), and (b) subcutaneous dirofilariasis caused primarily by *Dirofilaria tenuis* and *Dirofilaria repens*, parasites of the raccoon and of dogs and cats respectively. In rare instances the parasite has also been recovered from deeper locations of peritoneal cavity, omentum, ligaments, breast and liver (Padmaja et al. 2005; Orihel and Eberhard 1998; Mrad et al. 1999; Kim et al. 2002).

Dirofilaria repens is the commonest species identified in India. It belongs to the subgenus *Nochtiella*. Transmission to humans is via the bite of zoo-anthropophilic vector—the mosquito of the *Anopheles*, *Aedes* and *Culex* species. Clinically infection is apparent as a solitary subcutaneous nodule commonly in the head and neck region with or without pain. Identifying its characteristic longitudinal cuticular ridges by wet mount study or histopathological examination in conjunction with the typical clinical features is usually sufficient for diagnosis in most of the cases (Orihel and Eberhard 1998; Khurana et al. 2010).

Case reports

Case 1

A 37 year old female a resident of Karnataka presented with a slowly enlarging mass over the left side of the neck for 2 months. The mass was preceded by symptoms of itching, pain and fever. The mass measured 1.5 cm × 1 cm, was irregular, freely mobile and firm in consistency. The lesion was nontender and there was no local rise of temperature. Ultrasonography showed an oval hypoechoic lesion, 8 mm × 5 mm with tubular hyperechoic structure in the subcutaneous plane suggestive of inflammatory swelling due to parasitic infestation. The nodule was excised and the worm

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Fig. 1 Wet mount of the worm showing characteristic longitudinal cuticular ridges

was delivered out of the cystic lesion. The worm measured 11.5 cm in length and was identified as *D. repens* (Fig. 1).

Case 2

A 40 year old male, resident of Dakshina Kannada district of coastal Karnataka presented with swelling of the right upper eyelid for 2 weeks. On examination the swelling was associated with periorbital edema and tenderness. Computed tomographic scan suggested an inflammatory/malignant mass. The excised mass consisted of an irregular grey pink nodule measuring about 1 cm × 0.8 mm. Cut section showed a whitish centre. Microscopy revealed several cross-sections of a slightly degenerated worm showing the cuticular and internal structures (Fig 2).

Fig. 2 Photomicrograph of the slightly degenerated worm showing the multilayered cuticle, longitudinal ridges and the genital tube. H&E original magnification 40×

Discussion

Dirofilaria has widespread geographical distribution with cases recorded from over 30 countries. It has endemic foci in Southern and Eastern Europe, Asia Minor, Central Asia and Sri Lanka. World over around 800 cases of *Dirofilaria* are on record (Pampiglione et al. 1995, 1982; Pampiglione and Rivasi 2000).

Dirofilaria species isolated from humans are divided into two subgenera: *Dirofilaria*, with *D. immitis* as the type species, and *Nochtiella*, with *D. repens* as its type species. Nematodes in the former, have a smooth cuticle and are typically found in pulmonary arteries, whereas those in the latter (*D. repens*, *D. ursi*, *D. tenuis* and *D. striata*) exhibit longitudinal cuticular ridges and are usually found in subcutaneous tissues. Epidemiologically, the species recovered, depend upon the geographical location (Orihel and Eberhard 1998).

Dirofilaria is relatively rare in India with approximately 73 on record since 1977. *Dirofilaria repens* is the commonest species identified followed by *D. immitis* and *D. tenuis* (Joseph et al. 1976; Bhat et al. 2003, 2012; Terethanath and Hariprasad 2011; Badhe and Sane 1989; Senthivel and Pillai 1999). Two cases of *D. repens* were identified in our institute (Table 1).

Dirofilaria repens is the most prevalent agent of zoonotic dirofilariasis in many parts of the world including Africa, Canada, Japan Kuwait France, Italy, Turkey, Africa, Thailand, USA and Southeast Asia (Athari 2003; Sekhar et al. 2000).

Dirofilaria repens was first reported in India by Joseph et al. who described a case of ocular *Dirofilaria* in a patient from southern coastal state of Kerala. Following this, isolated case reports of *Dirofilaria* were published throughout the nineties. It is probable that the sudden spurt in the cases seen over the last decade is not only indicative of greater awareness of this entity but also an actual increase in its incidence (Fig. 3).

The state of Kerala has so far been the main reservoir of infection. Its close geographical proximity to Srilanka, one of the most affected countries may be the cause. Out of the 70 odd case reports, more than half of the patients either were residents of or provided history of travels to Kerala. Recent trends however indicate a northward migration of the disease with cases being reported from Karnataka and Maharashtra and occasionally from Northern and Eastern states of Assam, Bihar Orissa and Haryana (Gautam et al. 2002; Singh et al. 2010; Nath et al. 2010; Chopra et al. 2012).

The prevalence of microfilaremia in dogs in Kerala and Karnataka is around 7 and 21 % respectively. This high prevalence in dogs—both domestic and stray explains the high incidence of disease in these regions. Moreover, India

Table 1 Case reports of *Dirofilaria* in India with epidemiological details

Case No.	Author	Area	Location	Age	Sex	Worm sex	Number of worms	Length of the worm in cm	Species
1	Joseph et al. (1976)	Ker ^a	Conj ^b	60	F	F	1	NM ^c	<i>D. repens</i>
2	(Badhe and Sane 1989)	Maha ^d	Pulmonary	Child	NM	NM	NM	NM	<i>D. immitis</i>
3	(Senthivel and Pillai 1999)	Ker	SC ^e	NM	NM	NM	NM	NM	NM
4	Sekhar et al. (2000)	Ker	Eyelid	26	F	NM	2	10.5 and 5	NM
5	Nadgir et al. (2001)	Kar ^f	Conj	42	M	M	1	3.5	<i>D. repens</i>
6	Gautam et al. (2002)	Haryana	Sub conj	23	M	M	1	8.3	<i>D. repens</i>
7	Ittyerah and Mallik (2004)	Ker	Eyelid	14	F	F	1	10	<i>D. repens</i>
8	Bhat et al. (2003)	NM	Eyelid	70	F	NM	1	12	<i>D. tenius</i>
9	Padmaja et al. (2005)	TN	Lip	35	M	F	1	12.5	<i>D. repens</i>
10	Mahesh et al. (2005)	Asian	Eyelid	78	F	F	1	10	<i>D. repens</i>
11	Sathyan et al. (2006)	Ker	Subtenon	63	F	F	1	9.5	<i>D. repens</i>
12–20	Sabu et al. (2005)	Ker	9 Eye	NM	NM	11 F	Single	9–13.5	<i>D. repens</i>
21–23	Sabu et al. (2005)	Ker	3 SC	NM	NM	1 M	1	6	<i>D. repens</i>
24	Smitha et al. (2008)	Ker	Eyelid	40	F	NM	1	13.5	<i>D. repens</i>
25	Raju et al. (2008)	Ker	Eyelid	33	F	NM	1	9	<i>D. repens</i>
26	Raju et al. (2008)	Ker	Eyelid	46	F	NM	1	8	NM
27	(Dhar and Nambiar 2008)	Ker	Limbus	24	F	F	1	10.5	NM
28	(Chakrabarti et al. 2009)	Ker	Sub Conj	60	F	NM	1		<i>D. tenius</i>
29	Singh et al. (2010)	Orissa	Scrotum	40	M	F	1	10.5	<i>D. repens</i>
30	Nath et al. (2010)	Assam	Eyelid	23	F	F	1	12	<i>D. repens</i>
31	Nath et al. (2010)	NM	Eyelid	30	M	F	1	13	<i>D. repens</i>
32	Nath et al. (2010)	NM	Conj	70	M	F	1	12	<i>D. repens</i>
33	Khurana et al. (2010)	Kar	AB Wall ^g	16	M	F	1	9	<i>D. repens</i>
34	Khurana et al. (2010)	Maha	Cheek	45	M	F	1	8	<i>D. repens</i>
35	Khurana et al. (2010)	Maha	Eyelid	15	F	F	1	11.5	<i>D. repens</i>
36	(Joseph et al. 2011a, b)	Ker	Face	53	F	NM	1	NM	<i>D. repens</i> in 17 cases
37	(Joseph et al. 2011a, b)	Ker	Chest	60	F	NM	1	NM	<i>D. repens</i> in 17 cases
38	(Joseph et al. 2011a, b)	Ker	Cheek R	45	F	NM	1	NM	<i>D. repens</i> in 17 cases
39	(Joseph et al. 2011a, b)	Ker	Arm	19	F	NM	1	NM	<i>D. repens</i> in 17 cases
40	(Joseph et al. 2011a, b)	Ker	AB wall	1	M	NM	1	NM	<i>D. repens</i> in 17 cases
41	(Joseph et al. 2011a, b)	Ker	Canthus	27	M	NM	1	NM	<i>D. repens</i> in 17 cases
42	(Joseph et al. 2011a, b)	Ker	Flank	65	M	NM	1	NM	<i>D. repens</i> in 17 cases
43	(Joseph et al. 2011a, b)	Ker	Thigh	28	F	NM	1	NM	<i>D. repens</i> in 17 cases
44	(Joseph et al. 2011a, b)	Ker	Neck	48	M	NM	1	NM	<i>D. repens</i> in 17 cases
45	(Joseph et al. 2011a, b)	Ker	AB wall	34	F	NM	1	NM	<i>D. repens</i> in 17 cases
46	(Joseph et al. 2011a, b)	Ker	Arm	35	F	NM	1	NM	<i>D. repens</i> in 17 cases
47	(Joseph et al. 2011a, b)	Ker	Inguinal	38	F	NM	1	NM	<i>D. repens</i> in 17 cases
48	(Joseph et al. 2011a, b)	Ker	Arm	22	F	NM	1	NM	<i>D. repens</i> in 17 cases
49	(Joseph et al. 2011a, b)	Ker	Axilla	14	M	NM	1	NM	<i>D. repens</i> in 17 cases
50	(Joseph et al. 2011a, b)	Ker	Chest	25	M	NM	1	NM	<i>D. repens</i> in 17 cases
51	(Joseph et al. 2011a, b)	Ker	Neck	56	F	NM	1	NM	<i>D. repens</i> in 17 cases
52	(Joseph et al. 2011a, b)	Ker	Chest wall	50	M	NM	1	NM	<i>D. repens</i> in 17 cases
53	(Joseph et al. 2011a, b)	Ker	Nasolabial	10	F	NM	1	NM	<i>D. repens</i> in 17 cases
54	(Joseph et al. 2011a, b)	Ker	Parotid	39	F	NM	1	NM	<i>D. repens</i> in 17 cases
55	(Joseph et al. 2011a, b)	Ker	Epididymis	1	M	NM	1	NM	<i>D. repens</i> in 17 cases
56	(Joseph et al. 2011a, b)	Ker	Infraorbit	24	F	NM	1	NM	<i>D. repens</i> in 17 cases
57	(Teerthanath and Hariprasad 2011)	Ker	Muscle	27	M	M	1	16	<i>D. immitis</i>
58	Kotian et al. (2011)		Supra orbit	52	F	F	1		<i>D. repens</i>

Table 1 continued

Case No.	Author	Area	Location	Age	Sex	Worm sex	Number of worms	Length of the worm in cm	Species
59	Kotian et al. (2011)		Below eyelid	34	F		1		<i>D. immitis</i>
60	Permi et al. (2011)	Ker	Cheek	40	M	F	1	NM	<i>D. repens</i>
61	Permi et al. (2011)	Ker	Neck	45	M	NM	1	NM	<i>D. repens</i>
62	(Joseph et al. 2011a, b)	Ker	Orbit	50	F	F	1	12.5	<i>D. repens</i>
63	Sanjeev et al. (2011)	Ker	Neck	18	F	F	1	9	NM
64	Kotigadde et al. (2012)	Kar	Eyelid	47	F	F	1	10	<i>D. repens</i>
65	Chopra et al. (2012)	Bihar	Ant. ^h Chamber	25	M	F	1	10	NM
66	Bhat et al. (2012)	NM	Conjun	75	M	NM	1	NM	<i>D. tenius</i>
67	(Vaidya and Srikar 2012)	NM	AB wl	30	F	F	1	NM	<i>D. repens</i>
68	(Sangit and Haldipurkar 2012)	NM	Conjuc	48	M	F	2	3.5 cm	<i>D. repens</i>
69	Mukherjee et al. (2012)	Asian	Eyelid	61	M	NM	1	NM	NM
70	(Srinivasamurthy et al. 2012)	Indian	Neck	40	F	F	1	NM	NM
71	Sahdev et al. (2012)	Maha	Eye lid	3	M	NM	1	NM	<i>D. repens</i>
72	Case 1*	Kar	Neck	35	F	F	1		<i>D. repens</i>
73	Case 2*	Kar	Eyelid	45	M	NM	1		<i>D. repens</i>

M Male, F Female

* Cases received in our institute (unpublished)

^a Kerala

^b Conjunctiva

^c Not mentioned

^d Maharashtra

^e Subcutaneous

^f Karnataka

^g abdominal

^h Anterior chamber

is endemic for malaria and lymphatic filariasis. The humid climate and recent industrialization have given rise to a conducive atmosphere for the breeding mosquitoes. Hence, it is not surprising that the incidence of *Dirofilaria*, which shares its arthropod vectors with these, should also rise (Pampiglione and Rivasi 2000; Sahdev et al. 2012; Rani et al. 2010).

Dirofilaria in India is more common in females with the age range from 1 to 75 years. The details of socio-economic status/living conditions and loco—regional details including local vector control measures if any, residence in rural/urban regions and contact history with animals were not available (Bhat et al. 2012; Nath et al. 2010).

A single case of pulmonary *Dirofilaria* has been reported from India in a child manifesting as portal cavernoma with pulmonary dirofilariasis detected at autopsy (Badhe and Sane 1989).

Orbital/periorbital *Dirofilaria* accounted for more than half the number of cases with worms located in the eyelid, subconjunctival region, canthus, limbus, subtenon space and anterior chamber. Preferred location for subcutaneous

Dirofilaria was the head and neck, followed by face, arm and chest. The torso, thigh and scrotum were favoured locations in the lower half of the body. The distribution is similar to that observed by Orihel and Eberhard (1998). An isolated case of intramuscular *Dirofilaria* by *D. immitis* was reported (Teerthanath and Hariprasad 2011).

Where the sex of the worm was identified female worms were found with greater frequency than male worms (24 out of 27) which is in concurrence with the world literature. The male worms of *D. repens* ranged from 3.5 cm to 6 cm and female worms ranged from 10 cm to 13.5 cm. *D. tenius* was 12 cm to 16 cm.

Diagnosis of *D. repens* is mainly by morphological examination of the worm. An adult male worm is 5–6 cm long with anal spicules. The female are 10–17 cm long and 460–650 µm wide with a vulva 1.15–1.62 cm from the anterior end. More important are the morphologic features seen in transverse- sections of the worms. The cuticle is multilayered and has transverse striations with prominent longitudinal ridges. On the inner surface of the cuticle in the lateral fields, a conspicuous cuticular ridge protrudes

Fig. 3 Year-wise distribution of cases in India since 1977

into the inner surface of the lateral chords. The muscle coat is characteristically well developed. The number of reproductive tubes and their contents (eggs, microfilariae, and sperm) help identify the sex of the worm (Orihel and Eberhard 1998).

Dirofilaria repens reproduces sexually, its lifecycle consisting of five developmental stages requiring a vertebrate main host (usually a dog or cat) and an arthropod intermediate host/vector. The immature filaria migrate subcutaneously, undergoes development into an adult worm and then dies inciting an inflammatory reaction of the Th2 type dominated by eosinophils. Blood counts including the white cell differentials are usually within normal limits (Orihel and Eberhard 1998).

Conclusion

We support the opinion that *Dirofilaria* is emerging zoonoses in Indian subcontinent. With its increasing incidence it becomes imperative for the regional pathologists and microbiologists to be well versed with its morphology and the surgeons and ophthalmologists be aware of this parasite. A DNA study may help in further epidemiological characterization of the *Dirofilaria* species.

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