where both are co-endemic. The test is performed by intradermal inoculation of 0.01 to 0.1 ml of the test antigen (saline extract or purified antigenof adult *P. westermani*) on the volar aspect of the forearm, and the wheal diameters are measured immediately and 15 min after the inoculation. A differential wheal diameter of ⩾5 mm with erythema and pseudopodia indicates a positive test. Exceptionally, a large erythema of ⩾45x35 mm in diameters without an appreciable wheal and pseudopodia may indicate a positive reaction. Whereas a negative skin test almost certainly rules out paragonimiasis, a positive test cannot differentiate between the past and the present infection as the test may remain positive as long as 10 to 20 years even after the successful chemotherapy or spontaneous recovery[86]. There is also possible cross-reaction with other trematode infections such as schistosomiasis and clornorchiasis, if a crude antigen is used. However, the sensitivity and specificity of the test can be upto100 per cent by using purified antigen[87].

CFT has been used in the diagnosis of active infection and to confirm ID positive cases. The test becomes negative within 3 to 9 months after successful treatment[87]. It was recommended that ID test where used should be applied first in the epidemiological survey and followed by CFT or any other more specific test on individuals who showed positive or doubtful dermal reactions.

Biguet *et al*[87] first developed the immunodiffusion method for the diagnosis of paragonimiasis. Double immunodiffusion technique (Ouchterloney method), immunoelectrophoresis, and counter-current immunoelectrophoresis were reported to be highly sensitive and specific and can be used for speciation by demonstration of specific precipitin bands[88-90]. IHA is another simple, rapid and sensitive test. In Thailand, the test revealed asensitivity of 88 per cent in the diagnosis of paragonimiasis heterotrema[91].

ELISA test for paragonimiasis was first developed by Quicho *et al* in Thailand[92]. Since then ELISA based on different techniques and with different antigen preparations have been developed and evaluated for diagnosis of paragonimiasis[93-96]. The overall specificity of IgG ELISA using the saline extract of adult worms as an antigen was found to be 97 per cent. A 100 per cent sensitivity and specificity could be obtained in an indirect ELISA using F1 antigen fraction to detect antibody against *P. heterotremus* infection[97]. The various antigenic components such as 27 kDa possibly excretory/secretary (E/S) products of *P. westermani*[98] and 31.5 kDa substance of *P. heterotremus* were used as antigens for specific diagnosis of paragonimiasis and for serodiagnosis of human paragonimiasis heterotrema and therapeutic evaluation of praziquantel therapy[99], both by ELISA and Western blot, respectively. An enzyme-linked immunoelectrotransfer blot was developed for differential diagnosis between *P. heterotremus* and *P. westermani* infections[100]. Other ELISA techniques are sandwich ELISA using monoclonal antibodies-based antigen detection assay[101] and multiple dot-ELISA[95] now used in Japan. Generally, ELISA tests are used to detect parasite specific IgG antibodies but the detection of specific IgE antibodies was proven to reduce cross-reactions with other trematode infections and detection of parasite specific IgM antibodies was recommended in the diagnosis of infection at the early stage[102,103]. In India, Regional Medical Research Centre (RMRC, ICMR), Dibrugarh had developed IgG ELISA using E/S antigen for diagnosis of paragonimiasis and was reported to be highly sensitive and specific[104]. The ELISA tests are now most widely used for serological diagnosis of paragonimiasis due to their high sensitivity and specificity. The tests are also applicable to mass screening. However, ELISA tests are more expensive, time-consuming and require costly equipment and experienced persons and all the reagents, antigens, in particular, are not commercially available.

Rapid test: Recently, dot-immunogold filtration assay (DIGFA) kit was developed in China for anti-*P. westermani* antibody detection. This is found to be simple and rapid and does not require any special devices and/or experienced technicians and the results are obtained within 10 min. This kit was prepared using *P. westermani* antigen and reported in China to have the sensitivity and specificity up to 99 and 92 per cent, respectively[105].

Haematological investigation

Leucocytosis with relative lymphocytosis, eosinophilia and increased ESR were common findings in patients with paragonimiasis[33]. Most patients have haemoglobin value within normal limits in spite of frequent spiting of blood and recurrent haemoptysis. Eosinophilia (absolute eosinophil count >1000/µl) and increased ESR upto 104 mm at the end of 1st h (Westergren) were consistently found in children with paragonimiasis in Manipur[35].

X-rays and other imaging technique

The common radiographic findings were patchy air-space consolidation or opacity with associated pleural reaction or thickening, cystic or cavitary lesions, pleural

effusion (usually bilateral) and nodular opacities, which were difficult to differentiate from the similar lesions of tubercular origin. The chest radiographs showed patchy consolidations in 62-71 per cent, pleural thickening in 28 per cent, cystic or cavitary lesions in 11-14 per cent, effusion in 9-10 per cent, and nodular lesions in 8-13 per cent[33-35]. Persistent pleural effusion in nine patients was reported from Lao PDR of whom in 44.4 per cent patients showed bilateral effusion[69]. Compared to the chest X-ray, computerized tomography (CT) was found as a better technique for visualization of the lesions in the lungs[106]. Burrows and tunnels joining the cystic lesions have been described in broncho-tomogram or pulmonary CT[107,108]. Chest radiographs may be normal in symptomatic patients[31,32]. Higher rate of normal chest roentgenograms in pulmonary paragonimiasis was also reported from endemic areas in Nigeria[109]. CT and MRI of brain of cerebral paragonimiasis patients will show conglomerates of multiple ring-shaped shadows called the 'grape cluster' or 'soap bubble appearance'[110,111] or isodense lesion mimicking tuberculoma[77] in one hemisphere of the cerebral cortex.

Treatment

Three major antihelminthic drugs are currently available for treatment of paragonimiasis. Praziquantel is the drug of choice for both pulmonary and extra pulmonary paragonimiasis[112]. The recommended dose is 25 mg/kg body weight administered orally three times a day after meals for three days without any appreciable side effects. With this regimen relapse occurred in about 2 per cent cases. A 100 per cent cure rate was obtained when the therapy was extended up to 5 days[34]. Bithionol, 2, 2'-thiobis [4, 6-dichlorophenol] was the drug used before the praziquantel was available for the treatment of paragonimiasis. It is given in doses of 40 mg/kg body weight in two equally divided doses on alternate days for a course of 10 to 20 doses[33]. The most common side effect was urticaria, which was observed in about 50 per cent of patients after 2 or 3 doses of bithionol. Rarely, urticaria may be very severe requiring hospitalization and parenteral antihistaminics.The other side effects such as nausea, vomiting, diarrhoea and itching were generally few, mild and transitory. Zhong *et al*[113] had used bithionol to treat paragonimiais in doses of 50 mg/kg body weight per day on alternate days for 20 doses and found a cure rate of 97.1 per cent. Recently, triclabendazole {5-chloro-6 (2,3-dichlorophenoxy)-2methylthio benzimidazole}, a drug used in veterinary medicine was evaluated for the treatment of paragonimiasis in humans. Control trials have shown that triclabendazole when administered in a single dosage of 10 mg/kg body weight had comparable efficacy, safety and tolerability with praziquantel[114,115].

Conclusion

In the recent years, paragonimiasis has emerged as an important food-borne parasitic disease in India, mainly in the Northeastern States of India. Failure to recognize pulmonary paragonimiasis has resulted in over diagnosis of pulmonary tuberculosis and unwarranted antitubercular therapy, which will have a negative impact on the outcome of the Revised National Tuberculosis Control Programme, especially in the tuberculosis endemic areas. Mahajan emphasized the need to generate awareness among the clinicians and public regarding paragonimiasis and to consider this disease in the differential diagnosis of PTB in places where both co-exist[116]. *P. heterotremus* has been identified as the causative agent of human *paragonimiasis* in the northeast India. *Potamiscus manipurensis, M. lugubris* and *A. superciliosum* were identified as second intermediate crab hosts of *Paragonimus* in these regions. Further research work is required to determine the first intermediate snail hosts of *Paragonimus* species in India and the role of *P. skrjabini* and *P. westermani* in human paragonimiasis. The control strategies for paragonimiasis should include the epidemiological surveys to determine the magnitude of the problem, training of public health care providers about the diagnosis and management of paragonimiasis, screening of all patients attending TB clinics, DOTS microscopy centers, hospitals and rural health centers for both tuberculosis and paragonimiasis. People should be educated not to consume fresh and improperly cooked crabs and crayfish, and to clean hands, utensils, cutlery boards, strainers, knives, *etc.* after processing fresh crabs and crayfish. Public health authority should ensure the continuous supply of praziquantel in the hospitals and dispensaries. The problem of paragonimiasis is likely to continue in India unless awareness among public and medical practitioners is spread and appropriate control measures taken.

References

1. Procop WW. North American paragonimiasis (caused by *Paragonimus kellicotti*) in the context of global praragonimiasis. *Clin Microbiol Rev* 2009; *22* : 415-46.
2. Miyazaki I. Lung flukes in the world: Morphology and life history. In: *Symposium on Epidemiology of Parasitic Disease*. International Medical Foundation of Japan; 1974. p. 101-34.

3. Doanh PN, Le NT, Tat D. *Paragonimus* and paragonimiasis in Vietnam. In: Arizono N, Chai JY, Nawa Y, Takahashi Y, editors. *Asian Parasitology 1. Food-borne helminthiasis in Asia*. Chiba, Japan: Federation of Asian Parasitologists; 2005. p. 149-53.
4. Chung HL, Holy HHCP, Ts'ao WJ. Recent progress in studies in *Paragonimus* and paragonimiasis control in China. *Chinese Med J* 1981; *94* : 483-94.
5. Miyazaki I, Hirose H. Immature lung flukes first found in the muscles of wild boar in Japan. *J Parasitol* 1976; *62* : 836-7.
6. Cobbold TS. On some new forms of Entozoa. *Trans Linn Soc London* 1859; *22* : 363-6.
7. Kerbert C. Knowledge to Trematodes. *Zool Anz* 1878; *1* : 271-3.
8. Vevers GM. Observations on the genus *Paragonimus* Braun, 1899 with a redescription of *P. compactus* (Cobbold, 1859). *J Helminth* 1923; *1* : 9-20.
9. Gulati A. On the occurrence of a lung fluke *Paragonimus edwardsi*, n.sp. in a palm civet (*Paradoxurus grayi*) in Kumaon hills. *Mem Dept Agri India Vet Ser* 1926; *3* : 187-90.
10. Blair D, Xu Z-B, Agatsuma T. Paragonimiasis and the genus *Paragonimus*. *Adv Parasitol* 1999; *42* : 174-8.
11. Rao MAN. Lung flukes in two dogs in Madras Presidency. *Indian J Vet Sci Anim Hus* 1935; *5* : 30-2.
12. Srivastava HD. The occurrence of *Paragonimus westermani* in the lungs of cats in India. *Indian J Vet Sci Anim Hus* 1938; *8* : 255-7.
13. Singh NP, Somvanshi R. *Paragonimus westermani* in tigers (*Panthera tigris*) in India. *J wildlife Dis* 1978; *14* : 322-4.
14. Dutta SC, Gupta PP. Paragonimiasis in a bear cat (*Articus binturong*). *Ann Trop Med Parasitol* 1978; *72* : 391-3.
15. Ravikumar S, Vijyalakshmi V, Hanumantha Rao K. Trematodes of the mongoose *Herpestes edwardsii* Geofroy from Visakhapatnam District. *Proc Indian Acad Sci B* 1979; *88* : 421-4.
16. Gaur SNS, Tewari HC, Sethi MS, Prakash OM. Helminth parasites from tiger (*Panthera tigris*) in India. *Indian J Parasitol* 1980; *4* :71-2.
17. Parihar NS, Shrivastava SN. Bronchial hyperplasia in a tiger (*Panthera tigris*). *Indian J Anim Sci* 1988; *58* : 230-3.
18. Sano M, Agrawal MC, Kotwal PC, Gopal R. *Paragonimus* infection in tigers at Kanha National Park. *J Parasitol Appl Anim Biol* 1994; *3* : 115-6.
19. Singh TS, Mutum S, Razaque MA, Singh YI, Singh EY. Paragonimiasis in Manipur. *Indian J Med Res* 1993; *97* : 247-52.
20. Takeda M, Sugiyama H, Singh TS. Some freshwater crabs from Northeast India bordered on Myanmar. *J Teikyo Heisei Univ* 2012; *23* : 199-213.
21. Singh TS, Singh YI. Three types of *Paragonimus* metacercariae isolated from *Potamiscus manipurensis* in Manipur. *Indian J Med Microbiol* 1997; *15* : 159-62.
22. Singh TS, Singh YI, Singh KN. A case of paragonimiasis in a civet cat with a new *Paragonimus* subspecies in Manipur, India. *Indian J Pathol Microbiol* 1998; *41* : 351-3.
23. Singh TS. Occurrence of the lung fluke *Paragonimus hueit'ungensis*in Manipur, India. *Chinese Med J (Taipei)* 2002; *65* : 426-9.
24. Singh TS. Occurrence of the lung fluke *Paragonimus heterotremus* in Manipur, India. *Chinese Med Sci J* 2003; *18* : 20-5.
25. Singh TS, Singh ID, Sugiyama H. Possible discovery of Chinese lung fluke, *Paragonimus skrjabini* in Manipur, India. *Southeast Asian J Trop Med Public Health* 2006; *37* (Suppl 3): 53-6.
26. Narain K, Devi Rekha K, Mahanta J. *Paragonimus* and paragonimiasis - A new focus in Arunachal Pradesh, India. *Curr Sci* 2003; *l84* : 985-7.
27. Singh TS, Sugiyama H, Umehara A, Hiese S, Khalo K. *Paragonimus heterotremus* infection in Nagaland: A new focus of paragonimiasis in India. *Indian J Med Microbiol* 2009; *27* : 123-7.
28. Tandon V, Prasad PK, Chatterjee A, Bhutia PT. Surface fine topography and PCR-based determination of metacercariae of *Paragonimus* sp. from edible crabs in Arunachal Pradesh, Northeast India. *Parasitol Res* 2007; *102* : 21-8.
29. Devi KR, Rekha, Narain K, Agatsuma T, Blair D, Nagataki M, Wickramashinghe S, *et al*. Morphological and molecular characterization of *Paragonimus westermani* in northeastern India. *Acta Tropica* 2010; *116* : 31-8.
30. Surveyer. Case of Distoma Disease in India. *Indian J Med Res* (special Indian Sci congress) 1919; *1* : 214-6.
31. Singh YI, Singh NB, Devi SS, Singh YM, Razaque M. Pulmonary paragonimiasis in Manipur. *Indian J Chest Dis Allied Sci* 1982; *24* : 304-6.
32. Patil SD, Jindani IB, Bansal MP, Gaiwad KD. Paragonimiasis of the lung. *Ann Trop Med Parasitol* 1984; *78* : 445-8.
33. Singh TS, Mutum SS, Razaque MA. Pulmonary paragonimiasis: Clinical features, diagnosis and treatment of 39 cases in Manipur. *Trans R Soc Trop Med Hyg* 1986; *80* : 967-71.
34. Razaque MA, Mutum SS, Singh TS. Recurrent haemoptysis: Think of paragonimiasis. *Trop Doc* 1991; *21* : 153-5.
35. Singh TS, Singh PI, Singh LBM. Paragonimiasis: Review of 45 cases. *Indian J Med Microbiol* 1992; *10* : 243-7.
36. Singh TN, Singh HR, Devi KS, Singh NB, Singh YI. Pulmonary paragonimiasis. *Indian J Chest Dis Allied Sci* 2004; *46* : 225-7.
37. Singh TN, Kananbala S, Devi KS. Pleuropulmonary paragonimiasis mimicking pulmonary tuberculosis-a report of three cases. *Indian J Med Microbiol* 2005; *23* : 131-4.
38. Singh TS, Sugiyama H, Rangsiruji A, Devi KR. Morphological and molecular characterizations of *Paragonimus heterotremus*, the causative agent of human paragonmiasis in India. *Southeast Asian J Trop Med Public Health* 2007; *38* (Suppl 1): 82-6.
39. Devi KR, Rekha, Narain K, Bhattacharya S, Negmu K, Agatsuma T, Blair D, *et al*. Pleuropulmonary paragonimiasis due to *Paragonimus heterotremus*: molecular diagnosis, prevalence of infection and clinicoradiological features in an endemic area of northeastern India. *Trans R Soc Trop Med Hyg* 2007; *101* : 786-92.

40. Liu Q, Wei F, Liu W, Yang S, Zhang X. Pragonimiasis: An important food-borne zoonosis in China. *Trends Parasitol* 2008; *24* : 318-23.
41. Shimazu T. Experimental completion of the life cycle of the lung fluke, *Paragonimus westermani* in the laboratory. *Jpn J Parasitol* 1981; *30* : 173-7.
42. Gyoten J. Experimental infection of the fresh water crab, *Geothelphusa dehaani*, with the cercariae of *Paragonimus miyazakii*. *Jpn J Parasitol* 1986; *35* : 183-9.
43. Xie BW, Yang YS, Li QZ, Tanf LY. *Rana boulengeri* as the paratenic host of *Paragonimus skrjabini*. *Chinese J Parasitol Parasitic Dis* 1985; *3* : 157-9.
44. Shibahara T. The route of infection of *Paragonimus westermani* (diploid type) cercariae in the fresh water crab, *Geothelphusa dehaani*. *J Helminthol* 1991; *65* : 38-42.
45. Shibahara T, Nishhida H, Sasaki N. A case of multiple lung fluke (*Paragonimus westermani*) infection of a raccoon dog in Japan. *Jpn J Parasitol* 1985; *34* : 513-6.
46. Shibahara T, Nishhida H. An epidemiological survey of the lung fluke, *Paragonimus* spp. in wild mammals in northern part of Hyogo Prefecture, Japan. *Jpn J Vet Sci* 1985; *47* : 911-9.
47. Miyazaki I, Habe S. *Paragonimus westermani filipinus* Miyazaki, 1978, stat. n. occurring at Jaro, Leyte, the Philipinus. *Med Bull Fukuoka Univ* 1979; *6* : 447-62.
48. Habe S, Lai KPF, Agatsuma T, Ow-Yang C K, Kawashima K. Growth of *Paragonimus westermani* (Kerbert, 1878) in mammals and mode of transmission of the fluke among mammals. *Jpn J Trop Med Hyg* 1996; *24* : 225-32.
49. Valez I, Velasquez LE, Velez ID. Morphological description and life cycle of *Paragonimus* spp. (Trematoda: *Troglotrematidae*): causal agent of human paragonimiasis in Colombia. *J Parasitol* 2003; *89* : 749-55.
50. Guan XH. Paragonimiasis. In: LI YL, Guan XH, editors. *Human parasitology*, People's Public Health Press; 2005. p. 109-13.
51. Chen HT. The occurrence of a new type of *Paragonimus* and some clinical problems related to lungfluke in China. *Annual Report of the Chung Shang Medical College*; 1958. p. 192-3.
52. Chen HT. The Chinese species of paragonimid trematodes, their phylogenetic relationship and faunal distribution. *Acta Parasitologica Sinica* 1964; *1* : 53-68.
53. Chung HL, Hsu CP, Ho LY, Kao P C, Shao L, Chiu, FH, *et al.* Studies on a new lung fluke: *Paragonimus hueit'ungensis* sp. Nov. *Chinese Med J* 1977; *3* : 379-94.
54. Miyazaki I. *Illustrated book of Helminthic zoonoses*, 1st ed. Tokyo: International Medical Foundation of Japan; 1991.
55. Prasad PK, TandonV, Biswal DK, Goswami LM, Chatterjee A. Phylogenetic reconstruction using secondary structures and sequence motifs of ITS2 rDNA of *Paragonimus westermani* (Kerbert, 1878) Braun, 1899 (Digenea: Paragonimidae) and related species. *BMC Genomics* 2009; *10* (Suppl 3): S25.
56. Blair D, Agatsuma T, Watanobe T, Okamoto M, Ito A. Geographical genetic structure within human lung fluke, *Paragonimus westermani*, detected from DNA sequences. *Parasitology* 1997; *115* : 411-7.
57. Blair D, Chang Z, Chen M, Cui A, Wu B, Agatsuma T, *et al.* *Paragonimus skrjabini* Chen, 1959 (Digenea: Paragonimidae) and related species in eastern Asia: A combined molecular and morphological approach to identification and taxonomy. *Syst Parasitol* 2005; *60* : 1-21.
58. Waikagul J. A new species of *Paragonimus* (Trematoda: Troglotrematidae) from a cat infected with metacercariae from mountain crabs *Larnaudia larnaudii*. *J Parasitol* 2007; *93* : 1496-500.
59. Thaenkham U, Waikagul J. Molecular phylogenetic relationship of *Paragonimus pseudoheterotremus*. *Southeast Asian J Trop Med Public Health* 2008; *39* : 217.
60. Kawashima K, Sugiyama H, Ketudat P. *Paragonimus* in Asia: Biology, genetic variation and speciation. *Paragonimus Research Report* Number 2: Kawashima K, editor. Fukuoka, Japan: Kyushu University School of Health Sciences; 1989.
61. Shibahara T. Studies on lung fluke, *Paragonimus westermani* diploid type: In: Northern part of Hyogo Prefecture, Japan. III. Experimental oral infection with metacercariae of rats, with reference to juvenile worms removed from the muscle. *Jpn J Parasitol* 1984; *33* : 119-32.
62. Keiser J, Utzinger J. Emerging food-borne trematodiasis. *Emerg Infect Dis* 2005; *11* : 1507-14.
63. Toscano C, Yu SH, Nunn P, Mott KE. Paragonimiasis and tuberculosis, diagnostic confusion: A review of the literature. *Trop Dis Bull* 1995; *92* : R 1-R 26.
64. Singh TS, Sugiyama H, Devi Ranjana KH, Singh LD, Binchai S, Rangsiruji A. Experimental infection of laboratory animals with *Paragonimus heterotremus* metacercariae occurring in Manipur, India. *SEA J Trop Med Public Health* 2010; *1* : 47-51.
65. Narain K, Devi KR, Mahanta J. A rodent model for pulmonary paragonimiasis. *Parasitol Res* 2003; *91* : 517-9.
66. Chung HL, Ts'ao WJ. *Paragonimus westermani* (Szechuan variety) and a new species of lung fluke- *Paragonimus szechuanensis*, Part II. Studies on clinical aspects of paragonimiasis szechuanensis - a new clinical entity. *Chin Med J* 1962; *81* : 419-34.
67. Kulka F, Barabas M. Clinical aspects and X-ray diagnosis of paragonimiasis. *Acta Med* 1955; *7* : 371-90.
68. Uchiyama F, Moromoto Y, Nawa Y. Re-emergence of paragonimiasis in Kyushu, Japan. *Southeast Asian J Trop Med Public Health* 1999; *30* : 686-91.
69. Vidamaly S, Choumlivong K, Keolouangkhot V, Vannavong N, Kanpitaya J, Strobel M. Paragonimiasis: A common cause of persistent pleural effusion in Lao PDR. *Trans R Soc Trop Med Hyg* 2009; *103* : 1019-23.
70. Lei HH, Yen CK. Pathologic changes of paragonimiasis: A report of five cases. *Chin Med J* 1957; *75* : 986-1003.
71. Singh TS, Vashum H. Cutaneous paragonimiasis: A case report. *Indian J Pathol Microbiol* 1994; *37* : S33-4.
72. Higashi K, Aoki H, Takebayashi K, Morioka H, Sakata Y. Cerebral paragonimiasis. *J Neurosurgery* 1971; *34* : 515-28.
73. Chung YC, Wu TJ, Lee TC, Yang TC. Four cases of cerebral paragonimiasis. *J Formosan Med Assoc* 1953; *52* : 801-14.

74. Oh SJ. Cerebral paragonimiasis. *Trans Am Neurol Assoc* 1967; *92* : 275-7.
75. Choo JD, Su BS, Lee HS, Song CJ, Shin DW, Lee YH. Chronic cerebral paragonimiasis combined with aneurismal subarachnoid haemorrhage. *Am J Trop Med Hyg* 2003; *69* : 466-9.
76. Miyazaki I, Nishimura K. Cerebral paragonimiasis. In: Hornabrook RW, editor. *Topics on tropical neurology. Contemporary Neurology Series.* vol. 12. Philadelphia: FA Davis Company; 1975. p. 109-32.
77. Singh TS, Khamo V, Sugiyama H. Cerebral paragonimiasis mimicking tuberculoma: First case report in India. *Trop Parasitol* 2011; *1* : 39-41.
78. Chang KH, Cha SH, Han MH, Kim HD, Cho SY, Kong Y, *et al*. An imaging diagnosis of cerebral paragonimiasis: CT and MR findings and correlation with ELISA antibody test. *J Korean Radiol Soc* 1993; *29* : 345-54.
79. Vanijanota S, Radomyos P, Bunnag D, Harinasuta T. Pulmonary paragonimiasis with expectoration of worms: A case report. *Southeast Asian J Trop Med Public Health* 1981; *12* : 104-6.
80. Komiya Y, Yokogawa M. The recovery of *Paragonimus* eggs from stools of paragonimiasis patients by the AMS III centrifugation technique. *Jpn J Med Sci Biol* 1953; *6* : 207-12.
81. Singh SI, Singh LP, Sahu RP, Singh TS, Singh TD. *Paragonimus* ova in pleural fluid (a rare finding). *J Med Soc* 1994; *17* : 54-6.
82. Romeo DP, Pollock JJ. Pulmonary paragonimiasis: Diagnostic value of pleural fluid analysis. *South Med J* 1986; *79* : 241-3.
83. Yokogawa, M. *Paragonimus* and paragonimiasis. *Adv Parasitol* 1965; *3* : 99-158.
84. Sawada I, Takei K, Kato S, Hatsuyama S. Studies on the immunodiagnosis of paragonimiasis II. Intradermal test with fractionated antigen. *J Infect Dis* 1968; *118* : 235-9.
85. Yokogawa M, Tsuji M. Immunological diagnosis as the screening method of paragonimiasis in the endemic area of paragonimiasis. In: *Proceedings of the first regional symposium on scientific knowledge of tropical parasites*, University of Singapore. Singapore: UNESCO; 1962. p. 194-206.
86. Yokogawa M. Epidemiology and control of paragonimiasis. In: Sasam M, editor. *Parasitic diseases*. Smyposium on epidemiology of parasitic disease. Tokyo International Medical Foundation of Japan; 1974. p. 137-49.
87. Biguet J, Rose F, Capron A, Tranvaky P. Contribution of immunoelectrophoretic analysis to the knowledge of worm antigens: Practical effects on their standardization, their purification & diagnosis of helminthiasis by immunoelectrophoresis. *Rev Immunol Ther Antimicrob* 1965; *29* : 5-30.
88. Katamine D, Imai J, Iwamoto I. Immunological study on paragonimiasis. Agar-gel precipitation reactions in paragonimiasis. *Jpn J Trop Med Hyg* 1968; *10* : 28-38.
89. Tsuji M, Capron A, Yokogawa M. Immunodiffusion test in the diagnosis of paragonimiasis. Second international congress of parasitology. Colloquium on Immunodiagnosis, Washington D.C.; 1970. p. 6-12.
90. Tsuji M. On the immunoelectrophoresis for helminthological researches. *Jpn J Parasitol* 1974; *23* : 335-45.
91. Pariyanonda S, Maleewong W, Pipitgool V, Wongkham C, Morakote M, Intapan P, *et al*. Serodiagnosis of human paragonimiasis caused by *Paragonimus heterotremus*. *Southeast Asian J Trop Med Public Health* 1990; *21* : 103-7.
92. Quicho LP, Thamaparlerd N, Tharabanij S, Vajrasthira S. Human immune response of cats to *Paragonimus* infection. *Southeast Asian J Trop Med Public Health* 1981; *12* : 364-7.
93. Imai J. Evaluation of ELISA for the diagnosis of paragonimiasis westermani. *Trans R Soc Trop Med Hyg* 1987; *81* : 3-6.
94. Waikagul J. Serodiagnosis of paragonimiasis by enzyme–linked immunosorbent assay and immunoelectrophoresis. *Southeast Asian J Trop Med Public Health* 1989; *20* : 243-51.
95. Ito M, Sato S.Multidot enzyme-linked immunosorbent assay for serodiagnosis of trematodiasis. *Southeast Asian J Trop Med Public Health* 1990; *21* : 471-4.
96. Ikeda T, Oikawa Y, Nishiyama T. Enzyme-linked immunosorbent assay using cysteine proteinase antigens for immunodiagnosis of human paragonimiasis. *AmJ Trop Med Hyg* 1996; *55* : 434-7.
97. Indrawati I, Chaicumpa W, Setasuban P, Ruangkunaporn Y.Studies on immunodiagnosis of human paragonimiasis and specific antigen of *Paragonimus heterotremus*. *Int J Parasitol* 1991; *21* : 395-401.
98. Sugiyama H, Sugimoto M, Akaska K, Horiuchi T. Characterization and localization of *Paragonimus westermani* antigen stimulating antibody formation in both the infected cat and rat. *J Parasitol* 1987; *73* : 363-7.
99. Wongkham C, Maleewong W, Intapan P, Morakote N, Chaikumpa W. Partially purified antigens of *Paragonimus heterotremus* for serodiagnosis of human paragonimiasis. *Southeast Asian J Trop Med Public Health* 1994; *25* : 176-80.
100. Dekumyoy P, Waikagul J, Eom KS. Human lung fluke *Paragonimus heterotremus*: Differential diagnosis between *Paragonimus heterotremus* and *Paragonimus westermani* infections by EITB. *Trop Med Int Health* 1998; *3* : 52-6.
101. Zhang ZH, Zhang YJ, Shi ZM, Sheng KF, Liu LT, Hu ZG, *et al*. Diagnosis of active *Paragonimus westermani* infections with monoclonal antibody-based antigen detection assay. *Am J Trop Med Hyg* 1993; *49* : 329-34.
102. Ikeda T, Oikawa Y, Owhashi M, Nawa Y. Parasite specific IgE and IgG levels in the serum and pleural effusion of paragonimiasis westermani patients. *Am J Trop Med Hyg* 1992; *47* : 104-7.
103. Nakamura-Uchiyama F, Onah DN, Nawa Y. Clinical features of paragonimiasis cases recently found in Japan: parasite-specific immunoglobulin M and G antibody classes. *Clin Infect Dis* 2001; *32* : 171-5.
104. Narain K, Devi KR, Mahanta J. Development of enzyme – linked immunosorbent assay for serodiagnosis of human paragonimiasis. *Indian J Med Res* 2005; *121* : 739-46.
105. Gan Xiaoxian, Shi Xiaohua, Wang Yue, Wang Peng-peng, Shen Hui-ying, Zhu Ming-dong, *et al*. Development of rapid diagnostic kit (Dot Immunogold Filtration Assay) for detection of antibodies against *Paragonimus westermani*. *Chinese J Zoon* 2005; *21* : 988-90.

106. Vanijanota S, Bunnag D, Harinasuta T. Radiological findings in pulmonary paragonimiasis heterotremus. *Southeast Asian J Trop Med Public Health* 1984; *15*: 122-8.

107. Suwanik R, Harinasuta C. Pulmonary paragonimiasis: An evaluation of roentgen findings in 38 sputum positive patients in an endemic area in Thailand. *Am J Roentgenol* 1959; *81* : 236-44.

108. Im JG, Kong Y, Shin YM, Yang SO, Song JG, Han MC, *et al.* Pulmonary patragonimiasis: Clinical and experimental studies. *Radiographics* 1993; *13* : 575-86.

109. Nokolo C. Outbreak of paragonimiasis in Eastern Nigeria. *Lancet* 1972; *1* : 32-3.

110. Li HZ, Xie FW, Sun SC. CT findings in fresh cerebral paragonimiasis. *No Shinkel Geka* 1992; *20* : 91-7.

111. Cha SH, Chang KH, Cho SY, Han MH, Kong Y, Su DC *et al.* Cerebral paragonimiasis in early stage: CT and MR features. *AJR Am J Roengenol* 1994; *162* : 141-5.

112. Rim HJ, Chang YS. Chemotherapeutic effect of niclofan and praziquantel in the treatment of pulmonary paragonimiasis. *Korea Univ Med J* 1980; *17* : 113-8.

113. Zhong H L, He LY, Xu ZB, Cao WJ. Recent progress in studies of *Paragonimus* and paragonimiasis control in China. *Chin Med J* 1981; *94* : 483-94.

114. Belizario VY, Mallari AO, De Leon WU, Lucero AC. Assessment of efficacy, safety, and tolerability of praziquantel and triclabendazole in the treatment of paragonimiasis. *Southeast Asian J Trop Med Public Health* 2007; *38* (Suppl 1): 97-105.

115. Calvopina MH, Guderian Ronald H, Paredes Wilson Y, Cooper Philip J. Comparison of two single day regimens of triclabendazole for the treatment of human pulmonary paragonimiasis. *Trans Roy Soc Trop Med Hygiene* 2003; *9* : 451-4.

116. Mahajan RC. Paragonimiasis: An emerging public health problem in India. *Indian J Med Res* 2005; *121* : 716-8.

Reprint requests: Dr T. Shantikumar Singh, Professor & Head, Department of Microbiology, Sikkim Manipal Institute of Medical Sciences, Gangtok 737 102, Sikkim, India
e-mail: shantikumar_singh@rediffmail.com