CDAlert

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FOOD BORNE TREMATODE (FLUKE) INFECTIONS: A NEGLECTED HEALTH PROBLEM IN INDIA

INTRODUCTION

Food borne fluke infections/trematodiases are emerging as a major public health problem worldwide with over 40 million people affected and over 10% of world population at risk of infection. The major concentration of these infections is in WHO's Southeast Asian and Western Pacific Regions[1], where the epidemiological factors are conducive for transmission of these infections. Although seldom fatal, they can cause considerable morbidity resulting in economic losses in terms of loss of productivity, absenteeism and direct health care costs that may lead to complications and death.

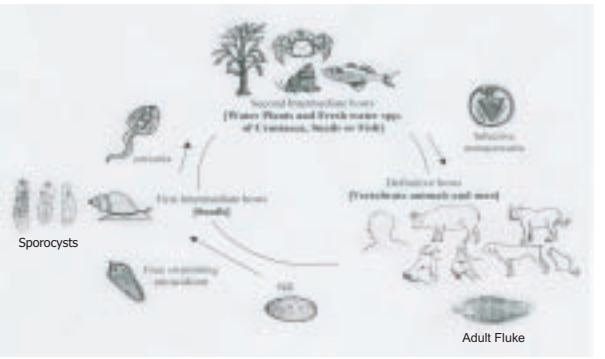
The preponderance of these infections is usually in food deficit poor communities residing in the interior and tribal areas due to their food habits (evolved in consonance with the meager available resources) and unhygienic sanitary habits (practiced due to lack of education). While targeting health for all, specially the poor tribal communities, it is imperative to take these infections into account. To focus the control strategies at the target populations, knowledge of the distribution and the probable endemic areas of the various infections is essential.

ETIOLOGY

Trematodiases are the zoonoses, caused by trematodes or flukes (Platyhelminthes: Trematoda: Digenea). The flukes are commonly oval or leaf shaped and furnished with two suckers (the anterior oral sucker surrounding the mouth and a posterior ventral sucker or acetabulam for adhering with their hosts).

Digenetic Trematodes have complicated life cycles that involve one or two intermediate hosts. The asexual phase includes eggs that develop into ciliated miracidia. Further development of this larval stage is possible only in the bodies of molluscs where it transforms into mother sporocyst. Germinal cells within the sporocyst develop either into rediae or daughter sporocysts but never both. There may be more than one generation of rediae or sporocysts. The final product of the asexual phase in molluscs is cercariae which are shed into water. They either enter the definitive host directly (Blood borne trematodes/ Schistosomes - have separate sexes and non operculated eggs) or encyst on objects or in the bodies of animals (second intermediate hosts), transforming into metacercariae the infective stage (Food borne trematodes - are hermaphrodites with operculated eggs). The definite host becomes infected by swallowing the metacercariae which develop to sexual maturity in various organs according to the species concerned (Fig. 1).

Fig.1 Life cycle of Food borne trematodes



[1] World Health Organisation. 1995. Control of food borne trematode infections, Geneva. Technical Report Series, No.849. P-102.

ECO-EPIDEMIOLOGY

The prerequisites for transmission of trematodiases in the community are:

1) Presence of water bodies with plenty of water plants to support the large snail populations (the first intermediate hosts) essential to perpetuate the life cycle of trematodes.

2) Consumtion of risky foods such as undercooked/pickled crabs, crayfish and fresh water fish or tubers and fruits of water plants (the second intermediate hosts harbouring metacercariae of the trematode spp., Table-1) harvested from these water bodies, by the population.

3) The contamination of water bodies with human/animal excreta leading to perpetuation of the foci of human infection of these zoonoses (Domestic or wild animals perpetuate the parasites in nature and are usually the principal definitive hosts).

Table 1. Trematode disease, its agent and source of infection

Disease	Causative agent/ species	Mode of transmission/ Second intermediate hosts
Echinostomiasis	*Echinostoma spp. Artyfechinostoma spp.*	molluscs, fish (in China, Japan and Republic of Korea) and amphibians (in Japan)
Heterophyiasis	*Heterophyes spp. Metagonimus yokogawai*	fish
Gastrodisciasis	*Gastrodiscoides hominis*	aquatic plants, frogs, tadpoles and crayfish
Fasciolopsiasis	*Fasciolopsis buski.*	aquatic plants
Fascioliasis	*Fasciola spp.*	aquatic plants
Clonorchiasis	*Clonorchis sinensis*	fish and crustacea
Paragonimiasis	*Paragonimus spp.*	crustacea viz., fresh water crabs and crayfish

Food borne trematodiases are thus a result of environmental, social and economic conditions prevailing in a region. Community sanitation, food habits and culture play an important role in their dissemination.

Epidemiologically, an area may be endemic with the right combination of environmental, social and economic conditions for propagation of the disease, when an indigenous case occurs there.

CLINICAL MANIFESTATIONS

Since the parasites are ingested with food they must pass the gastrointestinal (GI) tract and may cause symptoms there before reaching other tissues. Some parasites can invade intestinal tissues and reach blood and other body tissues. The dose required to produce the infection varies with the parasite. Depending on the dose, parasite and other factors, virtually, any tissue or organ of the body may be attacked. The symptoms, too, depend accordingly. Since the parasites must often multiply in the gastro intestinal tract or other tissues, the onset of the symptoms is delayed depending on the initial dose and the growth characteristics of the parasite. As GI tract is frequently the site of action, GI symptoms such as nausea, vomiting and diarrhoea are among the most common symptoms encountered.

Disease/illness is produced only when the defense mechanisms are overwhelmed by the parasites and is reflected in the tissues/organs, ultimately infected by the flukes (according to their disposition/affinity). Lungs, small intestines (except *Gastrodiscoides hominis* that inhabits large intestines) and liver or bile ducts are the final resting places of these flukes and accordingly, the symptoms are of the infected organ viz., respiratory, intestinal or hepatobiliary (Table-2). Flukes or their ova may also occupy ectopic locations such as viscera, intra-cranial cavity and subcutaneous tissues.

Table 2. Food borne Trematode disease and its clinical manifestations	
Disease	**Clinical Manifestations**
I. Intestinal Trematodiases	Heavy infections may cause
➢ Echinostomiasis	➢ abdominal pain, flatulence and diarrhoea, high eosinophilia
➢ Heterophyiasis	➢ chronic intermittent, often bloody diarrhoea along with dyspepsia, upper abdominal pain, anorexia, nausea, vomiting, weight loss and high eosinophilia
➢ Gastrodisciasis	➢ diarrhoea
➢ Fasciolopsiasis	➢ diarrhoea with epigastric pain (first symptoms). Toxic and allergic symptoms are oedema of face, abdominal wall and lower limbs, nausea and vomiting. Blood tests show anaemia, moderate leucocytosis with eosinophilia. Profound toxicity due to the absorption of the fluke metabolites, may result in death.
II. Liver and bile duct Trematodiases	
➢ Fascioliasis	➢ Migratory phase of flukes in liver parenchyma may be accompanied by fever, mild to severe abdominal pain, gastrointestinal disturbances, urticaria, dermatographia and cough. Clinical signs may include hepatomegaly, splenomegaly, ascites containing eosinophils and other leucocytes, mild to moderate anaemia with its accompanying symptoms, pulmonary signs, eosinophilia and jaundice. Latent phase when the flukes are in bile duct is generally asymptomatic and may last for several years. Only in some individuals it may lead to obstructive phase with chronic cholecystitis and cholangitis which may be accompanied by biliary colic, epigastric pain, jaundice, nausea, pruritis and right upper quadrant pain precipitated by fatty foods. Gall bladder enlargement and stones are frequently found in these patients. Ectopic infections are similarly represented by the associated symptoms.
➢ Clonorchiasis	➢ Fever, epigastric pain, anorexia, diarrhoea, hepatosplenomegaly, leucocytosis and eosinophilia; intense and chronic infection may lead to biliary and gall bladder stones and cholangiocarcinoma
III. Lung Trematodiases	
➢ Paragonimiasis	➢ Early clinical symptoms associated with the migration of young worms in the digestive tract and abdominal cavity are gastrointestinal diarrhoea and abdominal pain. During migration to lungs there may be allergic manifestations, urticaria and eosinophilia as well as fever, chills and chest pains. Once the worms establish in lungs the most common symptoms are cough and haemoptysis which may be accompanied by general malaise, and night sweats (imitating tuberculosis). Paroxysmal coughing pronounced in the morning produces upto 50ml of a gelatinous tenacious rusty brown blood streaked cough with parasite eggs. Ectopic infections of CNS, skin or elsewhere in the abdominal cavity are reflected by associated symptomology.

WHEN TO SUSPECT

1. Persons in the habit of consuming risky foods such as raw, undercooked or pickled fish, crabs, crayfish, or fresh water fish or tubers or fruits of water plants harvested from water bodies infested with snails
2. People practicing unhygienic habits and living in insanitary conditions.
3. A number of persons in the community having a set of intestinal, hepatic or respiratory clinical symptoms.

DIAGNOSIS

The definitive diagnosis is made through identification of the characteristic ova passed in stool, (in Paragonimiasis, also in sputum). However, the eggs of smaller trematodes viz., *Clonorchis sinensis, Opisthorchis* spp., *Metagonimus yokogawai* and *Heterophyes heterophyes* are difficult to differentiate. Specific confirmation here is usually possible from the adults recovered on autopsy or from faeces following treatment (Table-3). Some of the flukes, their infective metacercariae and diagnostic ova are shown in Plate-1.

Serological (Intradermal test or IDT) and Immunodiagnostic tests (ELISA) are of value for detection of prepatent and ectopic infection in Paragonimiasis (also for differential diagnosis from Tuberculosis) and hepatic trematodiases.

Table 3. Food borne Trematodes: comparative size of adults and their ova

Species	Egg morphology	Adult morphology
Clonorchis sinensis	27-35 x 12-19 µm; operculum seated on a prominent rim or shoulder, embryonated	body lanceolate; 10-25 x 2-4mm
Fasciolia hepatica	130-150 x 63-90µm; operculum inconspicuous, an irregularity in the shell wall at the opposite end to operculum; brown	Large about 3cm.
Fasciolia gigantica	140-190 x 80-104µm	body flattened, foliate; 25-75 x upto12mm
Fascioliolopsis buski	Same as *F. hepatica,* except the thickening at the abopercular end lacking	30-75 x 8-20mm,0.5-3mm in thickness
Gastrodiscoides hominis	130 x 60µm	Body large 4-8 x 3-4mm, more or less demarcated into anterior conical tapered region and posterior discoid region hollowed out ventrally to form a concave disc with papillar ridges
Metagonimus yokogawai	23.5-31.5 x 14.5-18µm with a smooth surface; operculum inconspicuous, embroyonated	Body tiny, spinose, 1-1.5 x 0.5mm
Echinostoma spp.	Ellipsoidal, thin shelled, unembryonated, yellow to yellow brown, (*E. iliocanum* : 83-116 x 53-82µm)	(*E. iliocanum* : 3-6.5mm with spines in most part of the cuticular body)
Paragonimus westermani	80-120 x 45-70µm, ovoid; golden brown with thick brown shell; operculum prominent	Body thick and fleshy; 8-12 x 4-6mm

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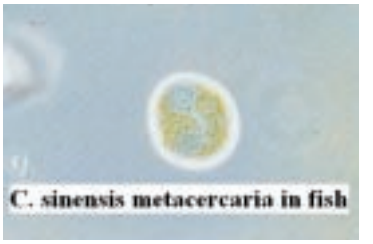

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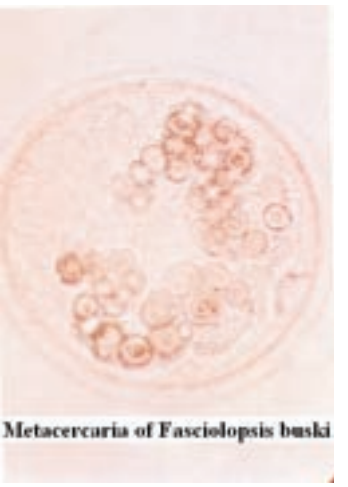

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Plate-I

Some Foodborne Trematodes (5,7,8) , their infective metacercariae (6,9,10,) and diagnostic ova (1,2,3,4)

HOW TO DIAGNOSE?

1. By identifying the characteristic operculated eggs passed in the stool.
2. By identifying flukes passed in sputum/stools (naturally or by drug induced purging).

CHEMOTHERAPY

Currently, the drug of choice in most trematode infections is Praziquantel, a safe and highly effective drug for the treatment of intestinal, liver (less effective against *Fasciola* infections and is reserved for situations when bithionol the more potent drug is not available) and lung infections. A single dose of 25mg/kg is recommended for treatment of intestinal fluke infections in adults and children over 4 years of age (for <4years dosage has not been established[2]). For liver fluke infections (other than Fascioliasis) the single dose is 40mg/kg. The dosage three times a day for two days has

[2] Parija, S.C. 2003. eMedicine – Trematode infection. P.12.

been observed to eliminate 100% infection in majority of liver and lung fluke infections. The recommended dosage for treatment of Fascioliasis is bithionol in dosages of 30mg/kg of body weight per day for five days.

HOW TO TREAT

1. Praziquantel in a single dose of 25mg/kg for >4years (except pregnant women), for intestinal infections.
2. Praziquantel 40mg/kg three times a day, for lung and liver fluke infection (other than Fascioliasis).
3. Bithionol 30mg/kg per day for five days, for Fascioliasis.

DOs and DON'Ts

1. Consume properly cooked foods.
2. Raw tubers, fruits and other edible parts of water plants should not be eaten or peeled with teeth.
3. the water reeds/sarkandas should not be put in mouth for playing as blow pipes.
4. Untreated water from water bodies harbouring plants, snails etc. should not be consumed as free metacercariae survive for a period of time.

Indian Scenario

Oriental Region with 41 trematode species recorded from human hosts has the second largest concentration (after the Palaearctic region with 73 spp.). Within the region the Southeast Asian countries bear the brunt of these infections[3].

In India epidemiological data on the distribution of these infections is extremely patchy and limited largely to the hospital based case reports where the culprit worms or the eggs have either been recovered from the vomit or stool of the patients or on autopsy. The data is thus reflective of only the extremely heavy and chronic infections where the distressed patients were compelled to seek help from a tertiary health facility.

[3] Ashford, R.W. and Crewe, W. 2003. The Parasites of *Homo sapiens*. An annotated checklist of the Protozoa, Helminthes and Arthropods for which we are home. Pp.142. Taylor and Fancis, London and New York.

Thirteen trematode species all belonging to the suborder Prostomata (with mouth terminal or subterminal), have been implicated (12)/ suspected (1) in human infections in India, till date, as per the available literature. The geographical distribution (reflecting the probable endemic areas) of the species in India is shown in the Map. The areas along with the number of cases recorded (in time and space) for the species (arranged alphabetically under the human organ finally parasitised by them), are detailed in the Table-4.

DISTRIBUTION OF FOOD BORNE TREMATODE INFECTIONS

1. *Artyfechinostomum malayanum* (Leiper, 1911)
2. *Artyfechinostomum oraoni* Bandopadhyay, Manna & Nandy, 1989
3. *Clonorchis sinensis* (Cobbold, 1875)
4. *Echinostoma ilocanum* (Garrison, 1908)
5. *Echinostoma malayanum* Leiper, 1911
6. *Fasciola hepatica* Linnaeus, 1758
7. *Fasciola gigantica* (Cobbold, 1875)
8. *Fasciolopsis buski* (Lankester, 1857)
9. *Gastrodiscoides hominis* (Lewis et McConneal, 1876)
10. *Metagonimus yokogawai* (Katsurada, 1912)
11. *Paragonimus heterotremus* Chen and Hsia, 1964
12. *Paragonimus skrjabini* Chen,1959
13. *Paragonimus westermani* (Kerbert, 1878)

Table 4. Distribution and load of Food borne Trematodiases in India		
	Species	**Distribution State: District - cases**
I	**Intestinal Flukes**	
	i. Echinostomatidae [30 cases recorded in time and space]	
1.	*Artyfechynostomum malayanum* (Leiper,1911)	Andhra Pradesh: West Godavari-1, Guntur-1 Assam: District ? [Sufrar]-1 Tamil Nadu: Chennai-1 Uttar Pradesh: Varanasi-1
2	*Artyfechynostomum oraoni* Bandhopadhyay, Manna & Nandy, 1986	West Bengal: 24 North and South Paraganas-20
3	*Echinostoma iliocanum* (Garrison, 1908)	Bihar-1
4	*Echinostoma malayanum* Leiper, 1911	Assam1 Uttar Pradesh: Lucknow/ Unnao-1 West Bengal: 24 North Paraganas-2
	ii. Fasciolidae [>409 cases recorded in time and space]	
5	*Fasciolopsis buski* (Lankester,1857)	Assam: Dhubri-1, Kamrup- Bihar: Darbhanga, Munger, Purnea, Saharsa-231 Maharashtra: Mumbai-38, Thane-83 Manipur: Imphal-6 Meghalaya: Shillong-40 Nagaland: Kohima-1 Orissa: Ganjam-4 Uttar Pradesh: Azamgarh-2, Bulandshahr-1, Unnao-182 West Bengal: 24 Paraganas-1, Kolkatta-1
	iii. Gastrodiscidae [>90 cases recorded in time and space]	
6	*Gastrodiscoides hominis* (Lewis et McConneal, 1876	Assam: Kamrup-88 Andhra Pradesh: Vishakhapatnam-1 Bihar: Meghalaya: Shillong-1 Orissa West Bengal
	iv. Heterophyidae [3 cases recorded in time and space]	
7	*Metagonimus yokogawai* (Katsurada, 1912)	Assam: Dibrugarh-2 Delhi-1
II	**Liver and bile duct flukes i. Fasciolidae [4 cases recorded in time and space]**	
8	*Fasciola gigantica* Cobbold, 1855	Chandigarh-1
9	*Fasciola hepatica* Linnaeus, 1758	Assam: Dibrugarh-1 Uttar Pradesh: Unnao-1, Varanasi-1
	ii. Opisthorchiidae [2 cases recorded in time and space]	
10	*Clonorchis sinensis* (Cobbold, 1875)	Assam: Dibrugarh-1 Manipur: Hills near Cachar-1
III	**Lung Flukes**	
	i. Paragonimidae [278 cases recorded in time and space]	
11	*Paragonimus heterotremus* Chen & Hsia, 1964	Arunachal Pradesh: Changlang-3 Manipur-suspected
12	*Paragonimus skrjabini* Chen,1959 (Suspected)	Manipur: Churachandpur- suspected
13	*Paragonimus westermanii* (Kerbert,1878)	Maharashtra: Aurangabad-1 Manipur: Imphal and various other parts-274

The infections have been recorded from the poor and tribal communities with risky food and unhygienic sanitary habits. These are usually from the interior and backward areas.

The tribals of northeastern states are genetically, culturally and ethnically aligned to the populations of the neighbouring countries of South-Eastern Asia and China, where these infections are most abundant. Their food and culinary habits, akin to those of the latter, predispose them to trematodiases. Additionally, populations around areas that are subject to seasonal flooding from the local rivers or have perennial water bodies, are prone to these infections. Since these water bodies are used by both the humans and animals for their daily needs, ideal conditions for perpetuation of the infections are created. Cultivation of edible plants, herein, further increases the chances of spread of infections in the communities that consume the cultivated products without taking necessary precautions. They are thus the vulnerable groups needing due attention in this regard.

A NEGLECTED DISEASE

Trematodiases have not received the desired attention largely because:

1) Concentration of infection is among the poorest of the poor and tribal people inhabiting the interiors of the country and
2) the infections though responsible for extensive morbidity in the affected populations are seldom fatal

Chronically infected people bear their misery stoically, rarely seeking medical advice and attention (as they neither have the means nor the resources for it). It is only when the burden of infections is extremely heavy leading to some chronic manifestation and terminal illness and thereby incapacitation that medical advice is sought. The problem has been resolved only when the patient has sought help from a tertiary referral facility (indicative of the lack of awareness about the infections at the peripheral level). Thus the knowledge about the extent of the problem, based on hospital based case reports, is only the tip of the iceberg.

This phenomenon is true world wide and specially true of the intestinal fluke infections where chronic and heavy infections do not lead to any dreaded disease. Consequently, they have received low attention which is responsible for their low percentage (constituting a meager 3% of all the reported trematodiases in the world). The utmost attention received by Paragonimiasis (disease caused by lung flukes) that mimics tuberculosis (a disease of paramount importance) is responsible for its largest share of all trematodiases in the world (>50%). Similarly, trematodiases due to liver and bile duct flukes (constituting 47% of all the trematodiases) have received due attention as the chronic disease may lead to some major pathological disturbances viz., biliary and pancreatic stones and cholangiocarcinoma.

PREVENTION AND CONTROL

The recommended strategies for the prevention and control of food borne trematode infection are as under:

- Surveillance to know the extent of infections and thereby its management - for prevention.
- Education and awareness in the community on trematode disease and its transmission - for prevention.
- Detection and treatment through appropriate diagnostic tools and drugs.

...about CD*Alert*

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