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Original Research Article

Cytomorphological spectrum and tissue reaction patterns in parasitic infections

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ABSTRACT

Background: Parasitic infections are prevalent in endemic regions and often present as subcutaneous swellings. Fine-needle aspiration cytology (FNAC) provides a rapid and minimally invasive diagnostic option. Objective was to evaluate the cytomorphological features and tissue reaction patterns in parasitic lesions diagnosed by FNAC.
Methods: An ambispective study of 40 FNAC-confirmed parasitic infection cases conducted over two years. Cytological smears stained with May-Grünwald-Giemsa were evaluated for parasitic elements and background response.
Results: Among 40 cases, cysticercosis (n=30) was most common, followed by hydatid cyst (n=6), filariasis (n=3), and leishmaniasis (n=1). Cysticercosis cases showed bladder wall fragments (83.3%), calcareous spherules (16.7%), and suppurative inflammation (76.7%). Hydatid cysts revealed scolices/hooklets and lamellated membranes; filariasis showed microfilariae and embryonated eggs with inflammatory backgrounds. Leishmaniasis demonstrated amastigotes in a subacute inflammatory background.
Conclusions: FNAC remains a valuable diagnostic tool for identifying parasitic lesions based on cytological hallmarks and associated tissue responses.

Keywords: FNAC, Cytology, Parasitic infections, Cysticercosis, Echinococcus, Filariasis, Leishmaniasis

INTRODUCTION

Despite remarkable progress in prevention and treatment, there is an increase in incidence of parasitic infections in developing countries. FNAC is a well-established diagnostic technique to aid in early diagnosis of the lesion, which can be managed conservatively and thus prevent undue surgery.[1] Parasitic zoonoses affect human as well as animal health directly or indirectly, which may affect the socio-economic condition of the country as a whole. Poor economic conditions, poor sanitation, improper water supply, and personal habits are some of the causes of harbouring parasitic zoonotic infections in the Indian subcontinent.[2] The incidence of these infections is slowly rising; hence active search for them in FNA smears in correlation with clinical history is yielding.[3]

Parasitic infections are common in developing countries, with India being the main harbor for tissue parasites like *Cysticercus cellulosae* and *Echinococcus granulosus*. *Wuchereria bancrofti* (filariasis) is confined chiefly along the sea coast.[4]

Cysticercosis is caused by the larval stage (cysticerci) of the pork tapeworm, *Taenia solium*. In India, it is more prevalent in the South-east. The two-host life cycle of the tapeworm comprises humans as definitive hosts and swine as intermediate hosts, with undercooked pork being the main source of infection. Humans can also become intermediate hosts by directly ingesting *T. solium* eggs shed in the feces of human carriers of the parasite. Therefore, cysticercosis is a human-to-human infection acquired by the fecal-oral route in areas of poor hygiene

and sanitation.[2] Common sites of infection include subcutaneous tissue, intermuscular fascia, muscles, and other organs.[3] Demonstration of fragments of larval bladder wall, hooklets, and calcareous corpuscles confirms the diagnosis of cysticercosis.[5,6]

The cysticercus secretes certain substances locally (e.g., paramyosin, taeniastatin), which alter the host immune response. Both cellular as well as humoral immunity are affected. With passage of time, these mechanisms may become ineffective, and the inflammatory response leads to degeneration of the parasite, granuloma formation, and calcification.[6]

Echinococcosis is caused by the larval stage of the dog tapeworm, the hydatid worm. Although hydatid disease is worldwide in distribution, it is most commonly found in countries where sheep and cattle raising constitute an important industry and is more commonly seen in temperate climates than tropical climates.[2]

Hydatid disease mainly affects the liver and lung, rarely lymph nodes, soft tissue, bone, brain, breast, thyroid, salivary glands, and kidney. Humans are accidental hosts via dogs or contaminated food. Subcutaneous cases are rare. Clear FNAC aspirates, with laminated membrane, hooklets, necrotic debris, and inflammatory cells, confirm diagnosis.[7]

Filariasis, caused by *Wuchereria bancrofti* and *Brugia malayi* via *Culex* mosquitoes, is a major public health issue in tropical India. Patients may be asymptomatic or develop chronic lymphedema and elephantiasis. Microfilaria appear in various tissues and rarely in malignant effusions.[8] Lymphatic obstruction or inflammation may explain their presence.[7]

Microscopy detects *Leishmania* amastigotes in skin, bone marrow, spleen, liver, lymph nodes, and blood, but not species. In cutaneous leishmaniasis, amastigotes appear in Giemsa-stained smears, round/ovoid, 1-5 µm, with nucleus and kinetoplast. Promastigotes are larger. Histopathology may obscure detection; both forms should be visualized for diagnosis.[9]

We studied the cytomorphological tissue reaction patterns induced by the most commonly encountered parasites.

METHODS

This descriptive-analytical study was conducted on 40 cases of parasitic infections diagnosed cytologically between January 2021 and December 2022 in the Department of Pathology, Sarojini Naidu Medical College, Agra, Uttar Pradesh. Cytological smears were stained with May-Grünwald-Giemsa (MGG) and evaluated for cellularity, background (necrotic or suppurative), presence of parasitic elements, and associated tissue reaction patterns such as necrosis, epithelioid cells, giant cells, and calcareous spherules. Samples were obtained by fine-needle aspiration (FNA) from clinically suspected lesions; both fresh aspirates (prospective) and archived smears (retrospective) were included.

All smears showing identifiable parasitic fragments, necrotic smears negative for acid-fast bacilli, and smears with eosinophilic infiltrate or granulomatous inflammation were included. Smears positive for acid-fast bacilli on Ziehl–Neelsen staining were excluded.

Data were analyzed using descriptive statistics. The study was approved by the Institutional Ethics Committee (IEC/2021/38), and informed consent was obtained from all prospective participants.

RESULTS

Demographics and site distribution

A total of 40 cases of parasitic infections were examined. Cysticercosis was the most frequent diagnosis (n=30, 75%), followed by hydatid cyst (n=6, 15%), filariasis (n=3, 7.5%), and leishmaniasis (n=1, 2.5%) (Figure 1). The demographic profile of patients is summarized in Table 1.

The study included 23 males (57.5%) and 17 females (42.5%). The age of patients ranged from 1 to 70 years, with a peak in the third decade. The head and neck region was the most common site of involvement (57.5%), followed by the chest wall (15%), upper extremities (12.5%), and others (15%).

Aspirate characteristics

The aspirated material was predominantly purulent in 20 cases (50%), followed by clear fluid in 16 cases (40%), particulate material in 3 cases (7.5%), and bloody aspirate in 1 case (2.5%) (Figure 2).

Cytomorphological spectrum

Cysticercosis (n=30) revealed bladder wall fragments in 25 cases (83.3%) and calcareous spherules in 5 (16.7%), as seen in Figure 4. The background showed suppurative inflammation in 23 cases (76.7%), granulomatous reaction in 5 (16.7%), and necrosis in 2 (6.7%).

Hydatid cyst (n=6) demonstrated scolices and hooklets in 3 cases (50%), lamellated membrane in 2 (33.3%), and hooklets alone in 1 (16.7%), with a necrotic background in 2 cases and no visible reaction in 4, illustrated in Figure 5. Filariasis (n=3) showed microfilariae in all cases, embryonated eggs in 1 case, and Charcot–Leyden crystals in 1, with a uniformly suppurative or necrotic background. Leishmaniasis (n=1) exhibited amastigotes within macrophages against a subacute inflammatory background, seen in Figure 6.

Tissue reaction pattern findings are concisely summated in Figure 3.

Table 1: Demographic profile of patients (n=40).

Parameters	Category	N	Percentage (%)
Age group (in years)	0-10	2	5.0
	11-20	5	12.5
	21-30	12	30.0
	31-40	9	22.5
	41-50	6	15.0
	>50	6	15.0
Sex	Male	23	57.5
	Female	17	42.5
Site of lesion	Head and neck	23	57.5
	Chest wall	6	15.0
	Upper extremities	5	12.5
	Others (trunk, lower limb)	6	15.0

Table 2: Parasitic type with their cytomorphological features.

Parasites	Key findings	Background reaction
Cysticercosis	Bladder wall, calcareous spherules	Suppuration, granulomas, necrosis
Hydatid cyst	Scolices, hooklets, lamellated membrane	Necrosis, acellular, minimal reaction
Filariasis	Microfilariae, eggs, Charcot-Leyden	Suppuration, necrosis
Leishmaniasis	Amastigotes	Subacute inflammation

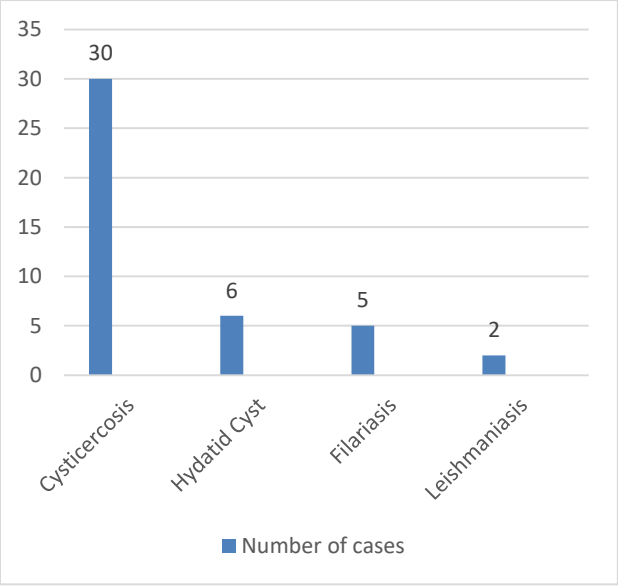

Figure 1: Distribution of parasites.

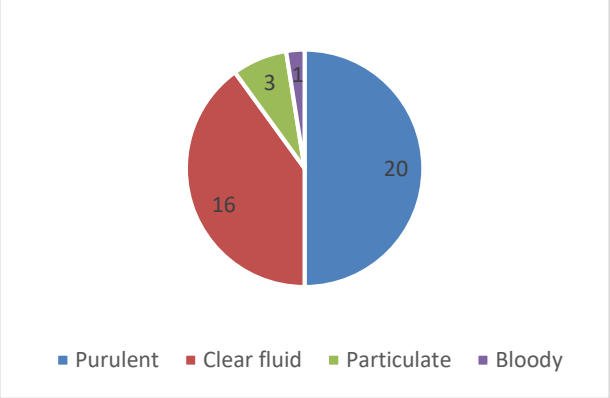

Figure 2: Distribution of nature of aspirate.

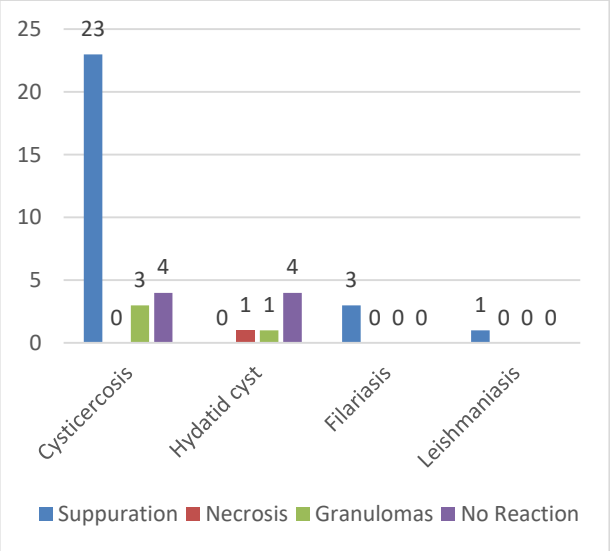

Figure 3: Tissue reaction patterns by parasite.

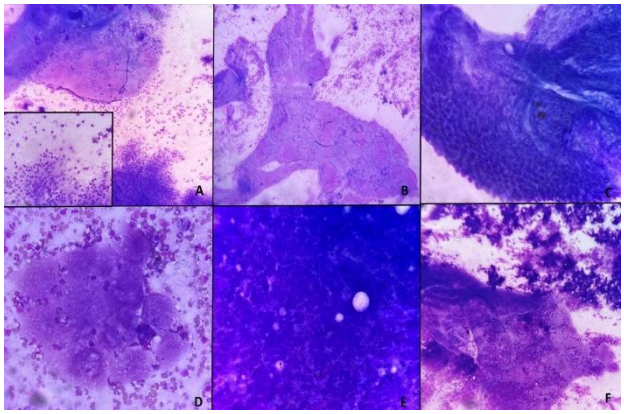

Figure 4: Cysticercosis and its various tissue reaction patterns: (A) bladder wall with granulomas, inset-granuloma (MGG, 100X, inset-400X); (B) bladder wall with inflammatory infiltrate (MGG, 100X); (C) bladder wall in a clean background (MGG,100X); (D) bladder wall in an inflammatory background (MGG, 400X); (E) calcerous spherules (arrow) (MGG, 400X); and (F) bladder wall in an inflammatory background (MGG,100X).

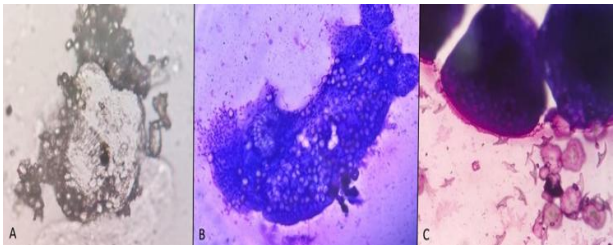

Figure 5: Echinococcus- (A) scolices on unstained smear (1000X); (B) scolices on unstained smear (MGG, 1000X); and (C) scolices and Hooklets (MGG, 400X).

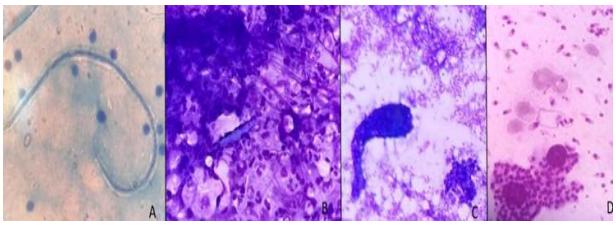

Figure 6: Microfilariae and leishmaniasis- (a) adult microfilaria (AFS, 100X); (B) Charcot-Leyden crystals with inflammatory infiltrate((MGG, 400X); (C) embryonated eggs((MGG, 400X); (D) asmastigotes of leishmania donovani within macrophages (MGG, 1000X).

DISCUSSION

Fine needle aspiration cytology (FNAC) has proven to be a highly efficient diagnostic modality in the evaluation of parasitic lesions, especially in endemic areas. This study demonstrates that FNAC can not only detect parasitic organisms such as *Cysticercus cellulosae*, *Echinococcus*, *Wuchereria bancrofti*, and *Leishmania*, but also delineate characteristic host tissue reaction patterns. The spectrum of these cytomorphological findings aligns with prior studies while also revealing certain unique observations (Table 2).

Cysticercosis was the most frequently encountered parasitic lesion in our study. FNAC features included bladder wall fragments (83.3%) and calcareous corpuscles (16.7%), often accompanied by suppurative inflammation (76.7%). Cysticercosis parasitic parts and its various tissue reaction patterns such as granulomas. These findings were supported by Kala and Khare, Handa et al and Pal et al.[5,6,9] Granulomatous reactions and histiocytic giant cells, although less frequent, were observed, comparable to findings by Gupta et al.[10] Hooklets, frequently noted in some literature, were absent in our cohort-mirroring observations by Gupta et al.[10]

Hydatid cyst cytology has been characterized by scolices, hooklets, and lamellated membranes. Most smears showed scant or necrotic background. Parasite on unstained and stained smears on a clear background. Our findings resonate with studies by Saenz-Santamaria and Moreno-Casado, Kapatia and Tom and Ascoli and Teggi.[11-13] Notably, tissue reaction was minimal in most cases, and only two exhibited necrotic backgrounds. This supports previous observations that hydatid lesions may not always elicit a strong inflammatory response.[2]

Microfilariae detection in three cases reflected typical features: sheathed worms in a background of neutrophilic infiltrate or suppuration. Embryonated eggs and Charcot-Leyden crystals were also visualized. These findings are concordant with the work of Mitra and Dey, Andola and Naik, and Gupta et al all of whom emphasized the diagnostic utility of FNAC even in clinically unsuspected cases.[10,14,15]

The single case of cutaneous leishmaniasis revealed amastigotes within macrophages in a background of subacute inflammation. This finding is consistent with the classical descriptions in the literature.[8]

This study's small sample size and single-center design may limit the generalizability of the findings. Inclusion of retrospective cases could introduce selection bias and variability in smear quality. Additionally, the absence of histopathological or molecular confirmation may affect the diagnostic accuracy of FNAC.

CONCLUSION

FNAC is a sensitive diagnostic modality regularly employed for parasitic infections. Our study emphasises that it allows evaluation of tissue responses as well in addition to the detection of specific morphological components. Early cytological identification of parasitic infections can facilitate timely and targeted therapy, especially in resource-limited endemic settings.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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