Cysticercosis is a systemic parasitic disease caused by larval stage of Taenia solium. It is the most common parasitic disease worldwide. It is potentially a dangerous systemic disease with variable clinical manifestations. It can be diagnosed by radiological imaging and serology but demonstration of parasitic larva by cytology or histopathology is still the gold standard. Fine needle aspiration cytology (FNAC) plays an important role in prompt diagnosis of this disease. **Aim:** To study the role of FNAC in the diagnosis of cysticercosis. **Materials and Methods:** This study included 30 patients presenting with palpable subcutaneous and intramuscular nodules at different sites. Fine needle aspiration was performed on these lesions and cytological features were analyzed. Subsequent excision biopsy was evaluated wherever possible. **Results:** Thirty patients in the age group of 7–80 years presenting with subcutaneous and intramuscular nodules at various sites were studied. Majority of the patients were males. The most commonly affected sites were upper and lower extremities and abdominal wall. Most of the cases were clinically misdiagnosed as lipomas, neurofibromas, lymphadenitis, epidermal inclusion cyst, sialadenitis, and soft tissue tumors. On cytological examination of aspirate from the lesions, fragments of parasite were seen in a background of mixed inflammatory cell infiltrate. Histopathological correlation was available in 17 cases. **Conclusion:** FNAC is a simple, sensitive, cost-effective, and rapid diagnostic tool for diagnosis of cysticercosis as cytological diagnosis is quite clear where the actual parasitic structures are identified in the smear.

**Keywords:** Cysticercosis, fine needle aspiration cytology, parasite
was noted and it was smeared on the glass slides. In case of fluid aspirated from cystic lesions, smears were prepared from cyst fluid after cytocentrifugation. The slides were stained with MGG stain after air drying and with Papanicolaou stain after fixation with 95% ethyl alcohol. Subsequent excision biopsy was evaluated wherever possible. The histopathological findings were correlated with cytological findings.

**RESULTS**

This study included 30 patients in the age group of 7–80 years. Majority of patients (30%) were in the age group of 21–30 years [Table 1]; 18 patients (60%) were males and 12 (40%) were females. The most common affected site was upper extremities (26.66% cases) followed by lower extremities and abdominal wall (16.66% cases each). Other affected sites were chest wall, back, neck, tip of tongue, and axilla [Table 2]. Two patients presented with multiple nodules. On local examination, swellings were soft to firm, nontender, and nodular and ranged in size from 1 to 4.5 cm. Provisional diagnosis of parasitic lesion was made in only one case, whereas the majority was clinically misdiagnosed as lipomas, neurofibromas, lymphadenitis, epidermal inclusion cysts, sialadenitis, and soft tissue tumors [Table 3]. Aspirated material in maximum number of cases consisted of clear fluid with granular deposits. In five cases, aspirate was purulent and in three cases it was hemorrhagic.

Microscopic examination of the smears revealed numerous fragments of the parasitic bladder wall in all cases. These appeared as granular, loose fibrillary sheath-like structures. The fragments had multiple subcuticular cells with small blue pyknotic nuclei [Figure 1a and b]. The background of the smears was dirty eosinophilic granular in 21 cases, clean in five cases and necrotic in four cases. Varying degrees of mixed inflammatory cell infiltrate were seen, which comprised eosinophils (21 cases), lymphocytes (23 cases), neutrophils (14 cases), and histiocytes, including palisading histiocytes (20 cases). Multinucleated foreign body type giant cells were seen in 13 cases. Fibroblasts were also seen in seven cases. None of the cases showed hooklets or scolices.

Histology was available in 17 cases. Larval *Taenia solium* cysts were seen in the sections in five cases. Lamellated multilayered cyst walls with protoscolices and suckers were identified in these sections. Hooklets were not seen [Figure 2a]. Rest of the cases showed fragments of cyst wall. The cyst wall fragments were multilayered with an outer cuticular layer, middle cellular layer, and an inner fibrillary layer [Figure 2b].

**DISCUSSION**

Cysticercosis has been termed as a “biological marker” of the social and economic development of a community.\[8\] It is a major public health problem, especially in the developing world, being endemic in Mexico, Central and South America, Asia, India, sub-Saharan Africa, and China.\[1,8-11\] Humans acquire this infection by drinking contaminated water or consumption of undercooked pork or raw vegetables, such as cabbage, radish, and carrots that harbor the larva.\[12,13\]

The clinical manifestations of the disease depend on location and number of lesions at a particular site.\[14\] Although the parasite can be found in any organ, they are especially common in central nervous system (CNS), eyes, skeletal muscle, and subcutaneous tissues.\[15\] All the cases in our study presented with subcutaneous and intramuscular nodules. Upper extremity was the most common site to be affected followed by lower extremity and abdominal wall. There was one case with nodule over the tongue, which is an unusual location for cysticercosis.\[16\] One case presented with multiple foci, which is also an unusual finding.\[17\]

The palpable parasitic nodules are often clinically misinterpreted as benign mesenchymal tumors, such as lipoma, neurofibroma, or as lymphadenopathy.\[15,18\] In our study too, all except one case were clinically misdiagnosed.

Various diagnostic modalities employed to detect cysticercosis include radiology, serology, and pathological examination.

### Table 1: Age distribution

| Age group (years) | Number of cases (n=30), n (%) |
|------------------|-------------------------------|
| 0-10             | 1 (3.33)                      |
| 11-20            | 4 (13.33)                     |
| 21-30            | 9 (30)                        |
| 31-40            | 3 (10)                        |
| 41-50            | 4 (13.33)                     |
| 51-60            | 4 (13.33)                     |
| 61-70            | 3 (10)                        |
| 71-80            | 2 (6.66)                      |

### Table 2: Sites of the lesions

| Affected site         | Number of cases (n=30), n (%) |
|-----------------------|-------------------------------|
| Upper extremity       | 8 (26.66)                     |
| Lower extremity       | 5 (16.66)                     |
| Abdominal wall        | 5 (16.66)                     |
| Chest wall            | 4 (13.33)                     |
| Back                  | 4 (13.33)                     |
| Cervical region       | 2 (6.66)                      |
| Tip of tongue         | 1 (3.33)                      |
| Axilla                | 1 (3.33)                      |

### Table 3: Provisional clinical diagnosis

| Clinical diagnosis   | Number of cases (n=30), n (%) |
|----------------------|-------------------------------|
| Lipoma               | 9 (30)                        |
| Soft tissue tumor    | 8 (26.66)                     |
| Neurofibroma         | 5 (16.66)                     |
| Epidermal inclusion cyst | 4 (13.33)                  |
| Lymphadenitis        | 2 (6.66)                      |
| Sialadenitis         | 1 (3.33)                      |
| Parasitic infestation | 1 (3.33)                    |
Computed tomography scan and magnetic resonance imaging, though sensitive in diagnosing cysticercosis, especially when the parasite involves the CNS, are very expensive. Serological tests are useful if positive but cannot rule out the disease with negative results. FNAC has emerged as a widely accepted method for diagnosis of cysticercosis. Aspiration of clear fluid is a strong pointer towards parasitic infestation, although in a significant number of cases aspirate may also be purulent or hemorrhagic. Majority of our cases (20) yielded clear fluid, whereas aspirate was purulent in five cases and hemorrhagic in four cases. Fully developed cysticerci are opalescent, milky white cysts, oval to elongated, and about 1 cm in diameter. The cyst contains clear fluid and invaginated scolex, which has a rosette of four suckers, and 22–32 small hooklets. On tissue sections, the cyst wall appears multilayered with an outer cuticular layer, which is smooth, hyalinized, frequently thrown into projections, and covered with microtrichiae. Beneath the tegument is a row of tiny tegumental cells. The inner layer or parenchyma is loose and reticular, containing mesenchymal cells and calcareous corpuscles.

The definitive cytological diagnosis of cysticercosis requires the demonstration of fibrillary sheath/bladder wall, hooklets, and calcareous spherules. However, in the absence of a parasitic wall/sheath, the following subtle morphological indicators give a clue to diagnosis: aspiration of clear watery fluid, dirty, necrotic, granular background in smears, host reaction comprising predominantly of eosinophils or mixed inflammatory infiltrate, palisading histiocytes, scattered plump fibroblasts, or multinucleated giant cells. The predominance of eosinophils in the background provides a vital clue to the parasitic etiology and should prompt the cytologist to search meticulously for a parasite or remnants of parasitic structures such as scattered calcareous spherules, or an occasional hooklet.

The presence of scolex in cytology smears is an unusual finding. In all our cases, we identified only the parenchymal layer with a loose fibrillary stroma. None of our cases showed hooklets/scolices. Goyal et al. have reported similar findings in their study. Histopathological correlation was available in 17 of our cases, which reconfirmed the diagnosis of cysticercosis. In studies by Handa et al. and Goyal et al., histopathological correlation was available in a small percentage of cases, which proves that FNAC alone can prove useful and cost-effective in the diagnosis of superficial cysticercal lesions.

Subcutaneous and intramuscular palpable parasitic nodule is most commonly due to cysticerci. Other parasites producing similar clinical presentation include Coenuri, the larval form of tapeworm of the genus Multiceps and Spargana, larva of Spirometra mansonoides. Hydatid cyst caused by larva of Echinococcus granulosus can also occur in the subcutaneous tissue as an unusual presentation.

Cytomorphological details of the aspirate help to differentiate these parasites [Table 4]. Cysticerci and Coenuri have suckers and hooklets, whereas Spargana do not. The Coenuri has multiple protoscolices distinguishing it from cysticercus which has a single scolex and is difficult to see in cytology smears. Bladder wall is thin and membranous in cysticerci, whereas it is thicker and lamellated in hydatid cyst. Multiple small scolices in the aspirate obtained from hydatid cyst are in contrast to the single scolex of cysticerci.

**Conclusion**

FNAC is a quick, reliable, and low-cost outpatient procedure for diagnosis of subcutaneous nodules caused by cysticercosis. It is one of the tools for preoperative diagnosis and may even obviate the need for open biopsy and subsequent histopathological examination as the parasite may not be demonstrated even in biopsy specimens. The cytological diagnosis is quite straightforward in cases where the actual parasite structure is identified in the smears. However, in other cases, the presence of eosinophils, histiocytes, and a typical

**Table 4: Distinguishing features of cysticercus cellulosae from other cestodes**

| Larval form         | Bladder wall       | Scolex   | Suckers and hooklets |
|---------------------|--------------------|----------|-----------------------|
| Cysticercus cellulosae | Thin and membranous | Single   | Present, Hooklets measure 130-170 µm |
| Echinococcus granulosus | Thick and lamellated | Multiple | Present, Hooklets measure 22-44 µm |
| Coenuri            | Thin               | Multiple | Present, Hooklets measure 40-175 µm |
| Spargana           | Absent             | Absent   | Absent                |
granular dirty background are the features which should always alert the pathologist to this possibility.\textsuperscript{[12,17]}

In all inflammatory/cystic lesions, particularly in endemic areas, the possibility of cysticercosis should be taken into consideration. An early diagnosis and prompt institution of therapy for superficial cysticercal lesions is essential to prevent dangerous sequelae. A rapid, safe, and reliable cytologic diagnosis of superficial cysticercal lesions by FNAC on an outpatient basis proves to be a cost-effective procedure.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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