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"Evaluating Treatment Outcomes: Comparative Analysis of Hematological and Immunological Profiles in Filarial Patients from Visakhapatnam and East Godavari Districts, Andhra Pradesh"

Sondi Thanuja Rani[1]*, Ummey Shameem[2]

[1*]Research Scholar (P.T), Department of Zoology, Andhra University, Vishakhapatnam
[2] Honorary Professor, Department of Zoology, Andhra University, Vishakhapatnam

***Corresponding Author:** Sondi Thanuja Rani
*Email: s.thanujarani@gmail.com

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ABSTRACT

Background: Filarial diseases, particularly lymphatic filariasis (LF), pose significant public health challenges in tropical regions, including Visakhapatnam and East Godavari districts of Andhra Pradesh, where *Wuchereria bancrofti* is predominantly responsible for infection. This study aims to assess the haematological and immunological changes in filarial patients before and after treatment to better understand the disease dynamics and treatment efficacy.

Methods: A hospital-based survey was conducted from June 2022 to June 2023, examining fever cases and filarial infections. Haematological parameters like lymphocyte and eosinophil counts, and immunological markers including immunoglobulin levels and lymphocyte subsets were analysed and, compared before and after filarial drug treatment.

Results: The study revealed significant haematological disruptions and elevated eosinophilia indicative of parasitic infections. Post-treatment, significant reductions in IgA, IgG, and IgM levels were observed, along with a notable decrease in the CD4/CD8 ratio, suggesting an effective modulation of the immune response. The majority of haematological and biochemical parameters remained within normal ranges, indicating a targeted immune response rather than generalized systemic effects.

Conclusion: The study underscores the persistent public health burden of lymphatic filariasis in endemic regions of Andhra Pradesh and highlights the importance of continuous monitoring of haematological and immunological profiles to enhance treatment strategies. The results advocate for sustained research and intervention efforts to mitigate the impact of filarial diseases on affected communities.

Keywords: lymphatic filariasis, *Wuchereria bancrofti*, haematological profiles, immunological profiles, treatment efficacy, Andhra Pradesh

INTRODUCTION

Filarial disease (FD) pose a substantial global health challenge, affecting an estimated 51 million people worldwide as of 2018 (WHO, 2024). Predominantly found in the tropical and subtropical regions of Africa, Asia, and Latin America, these diseases are caused by thread-like parasitic nematodes (roundworms) that are transmitted by vectors such as mosquitoes and black flies (Silva et al., 2021). Key manifestations of FD include lymphatic filariasis, onchocerciasis, and loiasis, which lead to debilitating conditions like lymphedema, elephantiasis, and river blindness. These conditions cause not only immense suffering and disability but also societal stigma and economic difficulties, particularly in the poor communities (Wynd, 2007). Despite concerted elimination efforts, filarial disease continues to be a significant public health issue, highlighting the urgent need for continued interventions and a greater emphasis on global health initiatives.

In India, lymphatic filariasis (LF) is the most common type of filariasis, predominantly caused by the nematode parasites

Wuchereria bancrofti and *Brugia malayi* (Abraham et al., 2024). Over 90% of LF cases are attributed to *Wuchereria bancrofti*, which is transmitted by the widespread vector, Culex *Quinque fasciatus* (Agrawal & Sashindran, 2006). The remaining cases, often found in the coastal regions of Kerala, Karnataka, and the north-eastern states, are caused by *Brugia malayi*, primarily transmitted by *Mansonia annulifera* (Kumar et al., 1998). LF can lead to chronic conditions such as hydrocele, characterized by fluid accumulation around the testicles, lymphedema, which involves swelling in the arms, legs, or genitals, and, in severe cases, elephantiasis, marked by thickened skin and tissues. As of 2023, India reported 619,000 cases of lymphedema and 126,000 cases of hydrocele (Ministry of Health & Family Welfare-Government of India, 2024). The disease significantly hinders economic development due to its debilitating effects, which reduce productivity and incur substantial medical costs (Barnett, 2006). Despite on-going control efforts, the persistence of these infections underscores the critical need for continued research and intervention strategies to effectively address this public health challenge.

The present study is set in the Visakhapatnam and East Godavari districts of Andhra Pradesh, marked by their tropical climates that foster the proliferation of mosquito vectors. These mosquitoes are primarily responsible for transmitting filarial worms, notably *Wuchereria bancrofti*. Recognized as endemic zones, these districts face substantial public health challenges due to lymphatic filariasis (Rao et al., 1980). Hematological and immunological profiles are vital for diagnosing, monitoring, and understanding the pathophysiology of filarial infections (Babu & Nutman, 2013). Variations in these profiles, including changes in lymphocyte counts and immunoglobulin levels, can signify an active filarial infection and gauge its severity (Babu & Nutman, 2012). There is a pressing need for a comparative analysis of these profiles before and after treatment to evaluate the effectiveness of existing filarial medications.

This research focuses on examining the hematological and immunological profiles of filarial patients from Visakhapatnam and East Godavari districts, with the goal of comparing these profiles before and after treatment. By measuring serum levels of IgA, IgG, and IgM, lymphocyte subsets, and liver function markers, this study aims to provide a detailed analysis of the hematological and immune responses during filarial infection. The expected outcomes will deepen our understanding of host-pathogen interactions in filariasis and aid in the development of enhanced therapeutic and management approaches for communities in these endemic areas.

MATERIALS AND METHODS

Study Design and Setting: The hospital-based survey was carried out weekly on 140 patients from June 2022 to June 2023 in the Visakhapatnam and East Godavari districts of Andhra Pradesh, enrolling participants specifically for this study. As per Indian census 2021, the population of Visakhapatnam and East Godavari districts are 10,78,444 and 13,62,063 respectively. According to Standard of NICD (National Institute of Communicable Disease, Delhi), the present study survey is conducted in 4 mandals each of Visakhapatnam (Population = 2,42,380) and East Godavari (Population = 2,32,241). The number of fever cases and LF cases are recorded.

Data collection: In the present cross-sectional study age and sex-wise incidence of fever cases was categorized into predefined age groups, with percentages calculated for each demographic category. Filarial patients were further examined for their demographic details and organ involvement, with manifestations classified into acute, chronic, and occult forms based on clinical presentations. Hematological analyses included a range of parameters such as lymphocyte, monocyte, polymorph, eosinophil counts, haemoglobin levels, and biochemical markers, classified as normal or abnormal against standard reference ranges. Additionally, immunological profiles of filarial patients were evaluated before and after treatment, focusing on immunoglobulin levels, lymphocyte subsets, and the CD4/CD8 ratio. Patients with missing clinical as well as laboratory parameters are excluded from the study.

Statistical Analysis: Data were analysed using SPSS software (version 24.0). Descriptive statistics were employed to summarize demographic, clinical, hematological, and immunological data. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were reported for continuous variables. Comparative analyses of immunological parameters pre- and post-treatment were performed using paired t-tests. A p-value < 0.05 was considered statistically significant.

RESULTS

The age- and sex-wise distribution of fever cases in the study area, highlighted variations across different demographic groups as illustrated in Table 1. For the youngest cohort (0–4 years), both male and female incidences were the lowest, each comprising 1% of total cases. Incidence rates increased in the 5–14 years group, accounting for 13% of cases among

males and 14% among females. A notable rise occurred in the 15–39 years category, where males represented 35% and females 41% of cases, marking this as the second most impacted group. The highest incidence was noted in individuals aged 40 years and above, with males constituting 50% and females 44% of cases. Overall, females (2,494 cases) exhibited a higher incidence compared to males (2,139 cases), with fever predominantly affecting older age groups.

Table 1: Age wise and sex wise incidence of fever cases in the study area

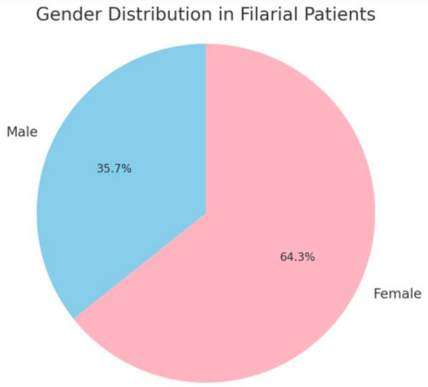
Age group	Males	% of cases	Females	% of cases
0-4 years	29	1%	37	1%
5-14 years	287	13%	341	14%
15-39 years	758	35%	1017	41%
40 years and above	1065	50%	1099	44%
Total	2139	99	2494	100

Table 2 provides a summary of the demographic data and organ manifestations in filarial patients. Out of the total 140 patients studied, females (64%) were more frequently affected than males (36%). The age distribution indicated that the vast majority of cases (94%) occurred in patients over 40 years old, with only a small percentage of cases in younger age groups—2% under 30 years old and 4% between 30 to 40 years old. Organ manifestations were divided into acute (A), chronic (C), and occult (O) forms across various sites. The left leg (LL) emerged as the most commonly affected area, exhibiting 21% of acute cases, 13% chronic, and 18% occult. The right leg (RL) followed, with 11% acute, 16% chronic, and 6% occult cases. Both legs (BL) had lesser degrees of involvement, with 4% acute, 3% chronic, and 2% occult cases. Hydrocele (HC) was noted in 4% of acute cases, while combined involvement of both legs/left hand (LL/LH) was relatively uncommon, accounting for 2% of the cases.

Table 2: Demographic and affected organ data for filarial patients

Variables	Frequency	Percentage
Sex		
Male	50	36%
Female	90	64%
Age group		
< 30	3	2%
30-40	6	4%
> 40	131	94%
Organs affected (Manifestation)		
BL(A)	6	4%
BL(C)	4	3%
BL(O)	3	2%
HC(A)	6	4%
LL(A)	29	21%
LL(C)	18	13%
LL(O)	25	18%
LL/LH(A)	3	2%
RL(A)	15	11%
RL(C)	22	16%
RL(O)	9	6%

BL, Both Legs; RL, Right Leg; LL, Left Leg; HC, Hydrocele; LH, Left Hand; (C), Chronic; (A), Accute; (O), Occult.



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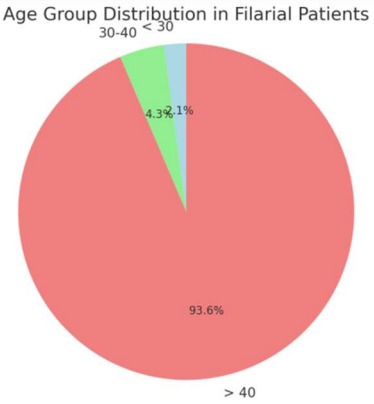

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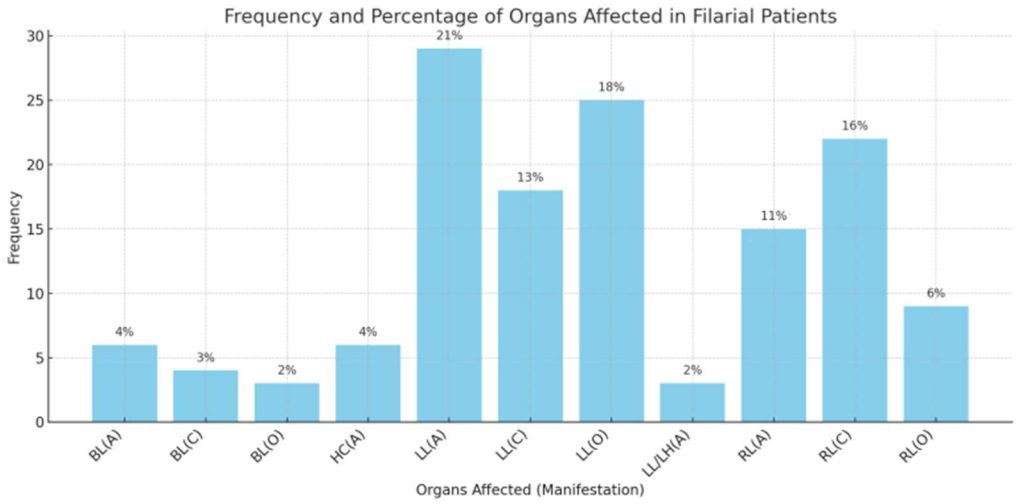

C

Figs. A-C: A: Age group distribution in Filarial patients; B: Gender distribution in filarial patients; C: Frequency of various organs affected in filarial patients.

The hematological profiles of filarial patients, showing notable immune system alterations and mild disruptions in other blood parameters are illustrated in table 3. While monocyte and polymorph counts were almost entirely normal (100% and 98%, respectively), lymphocyte abnormalities were observed in 46% of cases. Eosinophilia was prominent, with 69% of patients showing abnormal counts, which is a typical response to parasitic infections. Haemoglobin levels were normal in 89% of cases, with anaemia detected in 11%. Most patients had normal Red Blood Cells (RBCs), (98%) and platelet (78%) counts, while White Blood Cells (WBCs) abnormalities were seen in 26%, reflecting infection-induced inflammation. Biochemical markers like Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), and Alkaline Phosphatase (ALP) were normal in all patients, with only minor abnormalities (2–4%) in serum protein, albumin, and globulin levels. These findings emphasize eosinophilia and lymphocyte disruptions as key indicators of filarial infection.

Table 3: Hematological profiles of the Filarial patients in the study region

Parameters	Normal Range	Normal	%	Abnormal	%
Lymphocytes %	20-40%	75	54%	65	46%
Monocytes %	2-10%	140	100%	0	0%
Polymorphs %	40-60%	137	98%	3	2%
Eosinophils %	1-4%	44	31%	96	69%
Hb. (g/dl)	13.5-17.5 (men) 12.0-15.5 (women)	124	89%	16	11%
RBC (106/mm3)	4.7-6.1 (men) 4.2-5.4 (women)	137	98%	3	2%
WBC (103/mm3)	4.5-11.0	103	74%	37	26%
PLT (103/mm3)	150-450	109	78%	31	22%
Serum AST (U/L)	10-40	140	100%	0	0%
Serum ALT (U/L)	7-56	140	100%	0	0%
Serum ALP (U/L)	45-115	140	100%	0	0%
Serum total Protein (gm/dl)	6.4-8.3	137	98%	3	2%
Serum AL (gm/dl)	3.5-5.0	137	98%	3	2%
Serum GI. (gm/dl)	2.0-3.5	134	96%	6	4%

Table 4 highlights the immunological changes in filarial patients before and after antifilarial treatment. Significant reduction was observed in immunoglobulin levels, with IgA, IgG, and IgM showing marked decrease ($p < 0.0001$), indicating a suppression of hyperactive immune responses. While the lymphocyte count slightly increased post-treatment, the change was not statistically significant ($p = 0.365$). CD3 and CD4 counts also showed minor increases without significance ($p > 0.05$), whereas the CD8 count increased significantly ($p = 0.02$). The CD4/CD8 ratio decreased significantly ($p < 0.0001$), reflecting a shift in immune balance toward cytotoxic responses. These findings suggest that treatment effectively normalizes immunoglobulin levels and modulates T-cell activity, contributing to immune stabilization.

Table 4: Immunological profiles of filarial patients before and after treatment with anti-filarial drugs

Parameters	Pretreatment (n=140) *	Post treatment (n=140)*	P value
IgA (g/l)	6.25 ± 1.74	3.4 ± 1.25	< 0.0001
IgG (g/l)	18.68 ± 2.49	11.88 ± 3.7	< 0.0001
IgM (g/l)	3.49 ± 0.89	1.69 ± 0.7	< 0.0001
Lymphocyte count	2549.05 ± 650.9	2619.11± 639.73	0.365
CD3 Count	1662.12 ± 369.08	1728.39 ± 347.19	0.123
CD4 Count	740.93 ± 181.62	763.14 ± 172.77	0.295
CD8 Count	437.95 ± 136.02	474.29 ± 123.76	0.02
CD4/CD8 Ratio	1.73 ± 0.25	1.63 ± 0.21	< 0.0001

***Mean ± SD**

DISCUSSION

This study evaluated the hematological and immunological profiles of filarial patients in Visakhapatnam and East Godavari districts before and after treatment, providing a detailed analysis of how anti-filarial drugs influence these

parameters. Our findings reveal significant changes in both profiles, suggesting that the treatment not only affects the parasitic load but also has broader immunomodulatory effects. This study offers significant insights into the age- and sex-specific distribution of fever cases, the clinical manifestations of filarial infections, and the immunological and hematological profiles of those affected. Fever cases predominantly occurred in older age groups, with the highest incidence noted among individuals aged 40 years and above, particularly in males. While females exhibited a higher overall incidence of fever, a greater proportion of older males were affected, suggesting potential factors such as age-related immunological decline, gender-specific differences in immune response, and higher exposure risk to pathogens (Calabrò et al., 2023). Regarding filarial infections, the data indicate that females (64%) were more affected than males (36%), mirroring the age distribution seen in fever cases, with a significant burden also in the over-40 age group.

This age-related trend aligns with findings from a previous study on a north Indian population (Saeed et al., 2018). However, research from other regions, including Nigeria, Kenya, Varanasi, and Pondicherry, has reported a higher prevalence of filarial infections among males (Christiana et al., 2013; Njenga et al., 2009; Sharma et al., 1999; Rajagopalan et al., 1989), while studies in Karnataka and Orissa have shown higher rates of elephantiasis among females (Ravikiran et al., 2005; Babu, B. et al., 2001). These differing results across studies are likely due to a mix of biological factors, socio-cultural practices, and regional variations in study design and data reporting. In this study, the most commonly affected organs were the lower limbs, with the left leg (LL) being the most frequently involved, followed by the right leg (RL). Hydrocele (HC) was less commonly observed, present in 4% of cases, which suggests its association with filarial pathology predominantly in males (Yonder & Pandey, 2023). These findings underscore the complex interplay of demographic factors and disease dynamics in the epidemiology of filarial infections.

In lymphatic filariasis, patients typically show variations in various blood parameters when compared to healthy individuals (Sarojini&Senthilkumaar, 2013). Hematological parameters in filarial patients are expected to show significant improvement post-treatment (Andersen et al., 2019). Eosinophils are critical in combating parasitic infestations, and their increased levels are indicative of filarial infections (Gazzinelli-Guimaraes et al., 2024). Elevated eosinophil levels, observed in 69% of patients pre-treatment, should normalize as the parasitic load decreases and immune activation subsides. Additionally, lymphocyte abnormalities were observed in 46% of the cases, suggesting potential immune dysregulation (Szczawińska-Popłonyk et al., 2022).

Post treatment, abnormal WBC counts in 26% of patients are likely to stabilize, reflecting reduced systemic inflammation (Andersen et al., 2019). Anemia and platelet abnormalities, present in 11% and 22% of cases respectively, are anticipated to improve as treatment alleviates the underlying infection (Dolo et al., 2012). Despite the inflammatory nature of the disease, biochemical markers such as AST and ALT, remained within normal ranges. This suggests that filarial infections predominantly affect specific immune responses rather than causing broad systemic damage (Babu&Nutman, 2013).

Immunologically, there was a marked reduction in specific antibody levels (IgG, IgA, and IgM) post-treatment, indicative of a decreased antigenic stimulation from the filariae. This supports the hypothesis that successful treatment reduces pathogen load, thereby diminishing immune system engagement, which is in line with the previous research (Washington et al., 2004; Wamae et al., 1992; Ottesen et al., 1982). Previous studies have indicated an increase in CD4+ and CD8+ T cells among microfilaraemic patients, signalling chronic immune activation (Winkler et al., 1996). In contrast, the findings from this current study reveal more nuanced changes in T-cell subsets; while there was a significant rise in CD8 counts, the overall lymphocyte count, as well as CD3 and CD4 counts, remained relatively stable. A notable increase in CD8 count points to enhanced activation or proliferation of cytotoxic T-cells, which are essential for targeting and destroying infected or abnormal cells (Xie et al., 2021). These results suggest that antifilarial treatment may specifically modulate cytotoxic responses (CD8 T-cells) while preserving the balance of other immune system components, such as helper T-cells and total lymphocyte counts. This study shed light on the dynamics of immune system behaviour in response to filarial infection and subsequent recovery of post-medication.

Further research should focus on longitudinal studies to monitor the long-term effects of treatment on immune system dynamics and to explore the potential development of immune resilience or resistance to filarial infections. Additionally, expanding the scope to include molecular and bioinformatic analysis could provide deeper insights into the host-pathogen interactions and the mechanisms underlying immune modulation influenced by filarial infections and their treatment.

CONCLUSION

This study offers a comprehensive analysis of the hematological and immunological profiles of filarial patients in Visakhapatnam and East Godavari districts, both before and after anti-filarial treatment. Our results demonstrate

significant changes in these profiles, affirming the effectiveness of existing treatment protocols and shedding light on the intricate interactions between the filarial parasite and the host's immune system. The insights from this research emphasize the necessity of on-going surveillance and management in endemic areas. They underline the need for customized treatment strategies that not only target the parasitic infection but also take into account the wider immunological impacts. This investigation contributes crucial data that can help refine current treatment approaches and aid future public health initiatives aimed at eliminating filarial diseases in Andhra Pradesh and beyond. Consistent effort to expand this foundational knowledge will improve our strategies against filariasis and enhance health outcomes for affected communities.

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