

## Research Article

# A study of thyroid dysfunction in HIV infected patients in a tertiary care hospital

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### ABSTRACT

**Background:** Increasing prevalence of thyroid dysfunction has been reported in HIV-infected patients. However, there is insufficient evidence to recommend routine thyroid screening of asymptomatic individuals. Hence, this study was undertaken in an attempt to resolve these issues.

**Methods:** A cross sectional prevalence study was conducted on 75 adult HIV positive patients who did not suffer from hypertension, diabetes, coronary artery disease or thyroid disorder. A detailed history taking and examination was done and biochemical, microbiological and radiological tests were performed in order to reach a diagnosis. In addition, FT3, FT4, TSH and CD4 were done in all the patients.

**Results:** Overt hypothyroidism was found in 2 (3%), subclinical hypothyroidism in 10 (13%), isolated low FT4 in 2 (3%) and sick euthyroidism in 19 (25%) patients. As the stage of HIV advanced, the FT3 and FT4 levels went on decreasing. The TSH levels however, did not correlate with the stage of infection. A direct correlation was found between FT3 and CD4 counts and an inverse correlation between TSH levels and CD4 counts. The mean TSH levels in patients on HAART were significantly higher than in patients not on HAART. Cryptococcal meningitis was found to be associated with subclinical hypothyroidism, CNS toxoplasmosis with isolated low FT4 levels and tuberculosis with sick euthyroidism.

**Conclusions:** Thyroid dysfunction in HIV infected patients was largely asymptomatic. There was a direct correlation between WHO clinical stage of infection and serum FT3 and FT4 levels. TSH levels increased as CD4 counts decreased. Patients on HAART had a high prevalence of subclinical hypothyroidism. No association could be implied between opportunistic infections (OIs) and thyroid dysfunction, due to a small sample size.

**Keywords:** Thyroid dysfunction, HIV, Sick euthyroidism, Subclinical hypothyroidism

### INTRODUCTION

Abnormal thyroid function tests are common among human immunodeficiency virus (HIV)-infected patients.<sup>1-3</sup> In fact, thyroid dysfunction is among the commonest endocrinopathies in HIV. Although the prevalence of overt thyroid disease does not appear to be significantly increased as compared to the general population, subtle thyroid dysfunction is common, believed to occur in as many as 35% of all HIV infected individuals.<sup>1-4</sup> In patients with advanced HIV disease, a

variety of systemic opportunistic conditions that infect or infiltrate the thyroid can decrease or increase T<sub>4</sub> secretion.<sup>5</sup>

Less frequently, hypothalamic pituitary failure caused by central nervous system infections such as cryptococcosis or toxoplasmosis has been reported. In patients with AIDS, a high prevalence of sick euthyroid syndrome has been reported, probably due to a hypothalamic-pituitary deficit related to the progression of immunodeficiency and cachexia.<sup>6-8</sup> During antiretroviral therapy, the

prevalence of 2 generally asymptomatic conditions (subclinical hypothyroidism, which is characterized by isolated elevated thyroid-stimulating hormone levels, and isolated low free thyroxine levels) is increased.<sup>1,2</sup> In addition, Graves disease may occur during immune reconstitution.<sup>9</sup> The data on the prevalence of thyroid dysfunction in HIV infected patients from India is scant. Testing for thyroid disease among symptomatic patients should begin with measurement of the thyroid-stimulating hormone level.

However, there is insufficient evidence to recommend routine thyroid screening of asymptomatic HIV-infected individuals. Hence this study was undertaken, to evaluate the prevalence of thyroid abnormalities in a subset of HIV positive patients.

## METHODS

This cross sectional prevalence study was conducted on HIV positive adult patients admitted to the Department of Medicine at T.N. Medical College and B.Y.L Nair Charitable Hospital, Mumbai, India over a period of 18 months. The Institutional Ethics committee approval was obtained and a written informed consent was taken from all the patients. 75 adult males and females, who were HIV positive and admitted for various indications, were included in the study.

Patients who were pregnant, had a known thyroid disorder, had hypertension, diabetes, coronary artery disease or were on drugs known to interfere with thyroid metabolism such as glucocorticoids, octreotide, amphetamines, phenytoin, carbamazepine, etc., were excluded. Detailed clinical history was obtained and examination was performed, both for the current ailment and for thyroid related problems. Patients were classified according to WHO clinical stage for HIV. Besides routine investigations, patients were subjected to specific

microbiological, pathological and radiological investigations (such as sputum studies, blood culture, chest radiograph, abdominal or thoracic ultrasound, CT chest or brain) in order to diagnose the condition for which they were admitted. CD<sub>4</sub> counts were done in all the patients. FT3, FT4 and TSH levels were measured at the Endocrine Laboratory of our hospital by Chemiluminometric Immunoassay (Advia Centaur CP, Siemens, Germany). The coefficient of variance for FT3, FT4 and TSH was less than 5%. The normal range for TSH was 0.3-5.5 mIU/L. For FT4, the normal range was 0.8-1.8 ng/dl and that for FT3 was 1.7-4.2 pmol/L.

Anti-thyroid peroxidase (anti-TPO) antibodies were done in all cases by Chemiluminometric Immunoassay. The coefficient of variance for Anti-TPO was less than 10%. We did not require thyroid scan for any of the patients. Data analysis was done with the help of SPSS Software version 15 and Sigmaplot Version 11. Quantitative data is presented with the help of Mean and Standard Deviation, comparison between study groups was done with the help of Unpaired T test or Mann-Whitney test as per results of Normality test. Qualitative data is presented with the help of Frequency and Percentage table, association among study group is assessed with the help of Chi-Square test. P value less than 0.05 is taken as significant.

## RESULTS

75 HIV positive adult males and females, who were admitted to the wards for various indications, were included in the study. There were 49 males (mean age 39.82±12.04) and 26 females (mean age 36.77±8.74). Majority of the patients were in the age group 30 to 50 years. 47 patients (62.67%) presented with opportunistic infections (OIs), which was the commonest presentation. 12 (16%) patients were asymptomatic and were admitted for social reasons. Table 1 shows the distribution of the patients according to the clinical presentation.

**Table 1: Distribution of patients according to clinical presentation.**

Clinical presentation	No. of patients (%)	
Opportunistic infections	47	(62.67%)
Asymptomatic	12	(16%)
Monsoon related illnesses	4	(5.3%)
Nevirapine induced rash	2	(2.6%)
Lactic acidosis	2	(2.6%)
Severe anaemia	2	(2.6%)
ATT induced hepatitis	1	(1.3%)
Idiopathic thrombocytopenic purpura (ITP)	2	(2.6%)
Carcinoma Stomach	1	(1.3%)
Motor Neuron Disease (MND)	1	(1.3%)
Organophosphorus (OPC) Poisoning	1	(1.3%)
<b>Total</b>	<b>75</b>	

Out of the 75 patients, overt hypothyroidism was found in 2 (3%) patients, subclinical hypo-thyroidism was seen in 10 (13%) patients, isolated low FT4 was seen in 2 (3%) patients and sick euthyroidism was seen in 19 (25%)

patients. 42 (56%) patients were euthyroid. Anti-thyroid peroxidase antibodies were not positive in any of the patients. None of the patients were hyperthyroid (Table 2).

**Table 2: Thyroid function abnormalities in HIV infected individuals in the present study.**

Thyroid function abnormality	No. of patients	Percentage	Males	Females
Overt hypothyroidism	2	2.67%	1	1
Subclinical hypothyroidism	10	13.33%	7	3
Isolated low FT4	2	2.67%	2	0
Sick euthyroidism	19	25.33%	13	6
Hyperthyroidism	0	0	0	0
Euthyroidism	42	56%	26	16

**Table 3: Distribution of patients according to clinical stage.**

WHO clinical stage	Males	Females	Total
I	8	9	17
II	4	2	6
III	8	5	13
IV	29	10	39
Total	49	26	75

**Table 4: Distribution of Thyroid dysfunction according to WHO clinical stage**

Stages	Overt hypothyroidism	Subclinical hypothyroidism	Isolated low FT4	Sick euthyroidism	Total
I	0	0	0	3	3
II	0	2	0	0	2
III	0	3	0	1	4
IV	2	5	2	15	24
Total	2	10	2	19	33

**Table 5: Correlation between clinical stage and FT3 levels.**

FT3 (1.7-4.2 ng/dL)	N	Mean±SD	Oneway anova test	
Stage I	17	2.6±0.7	F Value	P value
Stage II	6	2.6±0.5	8.011	0.000
Stage III	13	2.4±0.6	Difference is significant	
Stage IV	39	1.9±0.5		

**Table 6: Correlation between clinical stage and FT4 levels.**

FT4 (0.8-1.8 ng/dL)	N	Mean±SD	Oneway Anova Test	
Stage I	17	1.2±0.3	F Value	P value
Stage II	6	1.3±0.2	2.732	0.050
Stage III	13	1.11±0.33	Difference is significant	
Stage IV	39	1.04±0.28		

We attempted to study the correlation between the WHO clinical stage and thyroid dysfunction by distributing the patients in the 4 clinical stages and comparing the mean TSH levels, FT4 and FT3 levels in each stage with each

other. There were 17 (22.67%) patients in stage I, 6 (8%) in stage II, 13 (17.33%) in stage III and 39 (52%) in stage IV (Table 3). Out of the 17 patients in Stage 1, only 3 (17.6%) had hypothyroidism which was sick

euthyroidism. None had overt or subclinical hypothyroidism or isolated low T4 levels. Out of the 6 patients in Stage 2, 2 (33.3%) had subclinical hypothyroidism. None had overt hypothyroidism or isolated low T4 levels. Out of 13 patients in Stage 3, none had overt hypothyroidism, 3 (23.1%) had

subclinical hypothyroidism and 1 (7.7%) had sick euthyroidism. No one had isolated low FT4 levels. In Stage 4, there were 39 patients, out of whom 2 (5.1%) had overt hypothyroidism, 5 (12.8%) had subclinical hypothyroidism, 2 (5.1%) had isolated low FT4 levels and 15 (38.5%) had sick euthyroidism (Table 4).

**Table 7: Correlation between clinical stage and TSH levels.**

TSH (0.3-5.5 mIU/L)	N	Mean±SD	Oneway anova test	
Stage I	17	2.8±0.9	F Value	P value
Stage II	6	3.9±2.1	1.032	0.384
Stage III	13	4.54±3.65	Difference is not significant	
Stage IV	39	3.95±3.01		

After these 75 patients were distributed from Stage 1 to Stage 4, we calculated the mean FT3, FT4 and TSH levels in each stage and results were analysed using ANOVA test. It showed that the levels of FT3 and FT4 went on decreasing from Stage 1 to Stage 4. However, the levels of TSH did not show any correlation with WHO clinical stage (Table 5-7).

CD4 count is the most important marker of severity of HIV infection and AIDS. We correlated the levels of FT3, FT4 and TSH with CD4 count. We divided all 75 patients (Mean CD4 count=232.4±181.9 cells/mm3) in three groups according to CD4 count, arbitrarily: 0-200 (Group A), 201-350 (Group B) and >350 cells/mm3 (Group C) (Table 8).

**Table 8: Distribution of patients according to CD4 counts.**

CD4 Count (mm <sup>3</sup> )	Males	Females	Total	Percentage
Group A	24	12	36	48%
Group B	15	10	25	33.33%
Group C	10	4	14	18.67%
Total	49	26	75	100%

**Table 9: Distribution of thyroid function abnormality according to CD4 counts.**

CD4 (mm <sup>3</sup> )	Overt hypothyroidism	Subclinical hypothyroidism	Isolated low FT4	Sick Euthyroidism	Total
Group A	1	6	2	13	22
Group B	1	4	0	5	10
Group C	0	0	0	1	1
Total	2	10	2	19	33

Out of 36 patients in group A (CD4 count ≤200 cells/mm3), 22 had thyroid function abnormalities. 1 (2.8%) had overt hypothyroidism, 6 (16.7%) had subclinical hypothyroidism, 2 (5.6%) patients had isolated FT4 levels and 13 (36.1%) patients showed sick euthyroidism.

Out of 25 patients in group B (CD4 count between 201 and 350 cells/mm3), 10 had thyroid function abnormalities. 1 (4%) had overt hypothyroidism, 4 (16%) had subclinical hypothyroidism and 5 (20%) had sick

euthyroidism. Out of 14 patients in group C (CD4 count >350 cells/mm3), only 1 patient had thyroid function abnormality, i.e. sick euthyroidism. None had overt hypothyroidism, subclinical hypothyroidism or isolated low FT4 levels (Table 9). We found a direct correlation between FT3 and CD4 count (r=0.3079 and p=0.0072) and an inverse correlation between TSH levels and CD4 count (r=-0.02561 and p = 0.0266).

It means as CD4 count decreases, FT3 levels go on decreasing and TSH levels go on increasing. The relation

between CD4 count and FT4 levels was not significant (Table 10). Out of the 75 patients, 39 were on HAART and 36 were not on HAART. The difference in the FT3 and TSH levels between the two groups i.e. patients on HAART and patients not on HAART was found to be significant (p value = 0.03 for FT3 and 0.02 for TSH).

The mean TSH levels in patients on HAART were significantly higher than in patients not on HAART. It means that hypothyroidism is more prevalent in patients on HAART than in patients' naïve to HAART (Table 11).

**Table 10: Correlation between thyroid function tests and CD4 count.**

Study parameters	N	Mean±SD	Current CD4 count (mm3)		
			Pearson Correlation	P value	Correlation is
FT3 (1.7-4.2 ng/dL)	75	2.189±0.64	0.3079	0.0072	Significant
FT4 ( 0.8-1.8 ng/dL)	75	1.1223±0.30	0.1658	0.1551	Not significant
TSH ( 0.3-5.5 mIU/L)	75	3.7921±2.76	-0.2561	0.0266	Significant

But in univariate analysis, out of the 6 HAART drugs (Zidovudine, Stavudine, Lamivudine, Tenofovir, Nevirapine and Efavirenz), none of the above drugs was found to be significantly associated with subclinical hypothyroidism. 47 out of 75 patients (62.67%)

presented with opportunistic infections. Majority i.e. 26 (34.7%) patients presented with pulmonary or extrapulmonary tuberculosis, 3 patients had pneumocystis jiroveci pneumonia, 4 presented with cryptococcal meningitis, 2 had CNS toxoplasmosis and 9 presented with bacterial infections.

**Table 11: Correlation between thyroid function abnormality in patients on HAART and patients not on HAART.**

Study parameter	Study group	Mean±SD	Unpaired T test	P value
FT3 (1.7-4.2 ng/dL)	On HAART	2.35±0.63	2.28	0.03
	Not on HAART	2.02±0.61	Difference is significant	
FT4 ( 0.8-1.8 ng/dL)	On HAART	1.11±0.27	0.49	0.63
	Not on HAART	1.14±0.33	Difference is not significant	
TSH ( 0.3-5.5 mIU/L)	On HAART	4.52±3.35	2.47	0.02
	Not on HAART	3.00±1.65	Difference is significant	

In the present study, from the analysis of the thyroid function abnormalities in opportunistic infections by unpaired T test, cryptococcal meningitis was found to be associated with subclinical hypothyroidism (p value=0.023 for FT3 and 0.028 for TSH). CNS toxoplasmosis was found to be associated with isolated low FT4 levels (p value=0.031 for FT4) and tuberculosis was found to be associated mainly with sick euthyroidism (p value = 0.0 for FT3 and 0.007 for FT4).

**DISCUSSION**

Endocrine system is one of the important systems involved in HIV, and in this, thyroid gland involvement is most commonly described. Subtle abnormalities in thyroid function are common in HIV positive individuals. The cause of this is multifactorial viz. opportunistic infections or tumours occurring in patients at the symptomatic stage of infection, defective function of the immune system, antiretroviral drugs used or a direct effect of HIV itself.<sup>1,2</sup>

There are many studies showing correlation between HIV infection and its associated conditions like stage of infection, CD4 count, OIs, HAART and thyroid dysfunction. However, these correlations are unclear. We have tried to study the correlation between HIV infection and its associated conditions and thyroid dysfunction in our tertiary care hospital using a cross sectional prevalence study for a period of 18 months. 75 HIV positive patients at various stages of illness were enrolled. 49 (65.3%) were males and 26 (34.7%) were females. Mean age of males was 39.82±12.04 years and that of females was 36.77±8.74 years. Male to female ratio was 1.89: 1. They were admitted for various indications (Table 1). 33 out of the 75 patients (44%) had some form of thyroid dysfunction.

In present study, 'clinical' (overt) hypothyroidism was seen in 2 (2.66%) patients, 10 (13.33%) had 'subclinical hypothyroidism', 2 (2.67%) had 'isolated low T4 levels' and 19 (25.33%) patients had 'sick euthyroidism' (non-thyroidal illness). None of the patients were found to be

hyperthyroid. Beltran in a similar study reported overt hypothyroidism in 2.6%, subclinical hypothyroidism in 6.6% and an isolated low T4 level in 6.8% of 350 subject's studied.<sup>1</sup> Low free T4 levels (1.3%) and subclinical hypothyroidism (3.5%) which correlated with low CD4 counts were reported in a Spanish population.<sup>10</sup> In a similar study by Raffi et al in 1991, the main abnormalities were sick euthyroid syndrome with low tri-iodothyronine and/or thyroxine in 16% of patients.<sup>7</sup> In a study by Quirino T et al, out of total 687 patients, 51 (7.42%) were subclinically hypothyroid.<sup>11</sup>

Madge et al, reported that out of 1565 patients, thirty-nine (2.5%) were found to have overt hypothyroidism, and eight (<1%) had overt hyperthyroidism.<sup>12</sup> Sixty-one (4%) had subclinical hypothyroidism, five (<1%) had subclinical hyperthyroidism and 263 (17%) had a nonthyroidal illness. A normal TFT was obtained in 1118 patients (75.5%).<sup>12</sup> Prevalence of overt primary hypothyroidism in the general population and HIV infected individuals from different studies across the globe has been reported to be 0.3% and 0–2.6%, respectively.<sup>1,2,7,10</sup>

Similarly, the prevalence of subclinical hypothyroidism has also been reported to be higher in HIV infected individuals as compared to the general population (4.3% versus 3.5–12.2%) in different studies.<sup>1,2,7,10-13</sup>

Especially among those who are receiving HAART. However, among patients with HIV infection and subclinical hypothyroidism, anti-thyroid peroxidase antibodies are rarely identified, in contrast to the 50-80% positivity rate in the general population, suggesting that the etiology may not be autoimmune.<sup>1,4</sup> None of present patients were positive for anti TPO antibodies. There were 17 (22.67%) patients in stage I, 6 (8%) in stage II, 13 (17.33%) in stage III and 39 (52%) in stage IV. Maximum patients presented in stage IV.

Out of the 17 patients in Stage 1, only 3 (17.6%) patients had hypothyroidism which was sick euthyroidism which may be due HIV infection itself. None had overt or subclinical hypothyroidism or isolated low FT4 levels. The mean TSH level in Stage 1 was  $2.8 \pm 0.9$  mIU/L. Out of the 6 patients in Stage 2, 2 (33.3%) had subclinical hypothyroidism. No one had overt hypothyroidism or isolated low FT4 levels. The mean TSH level in Stage 2 was  $3.9 \pm 2.1$  mIU/L.

Out of 13 patients in Stage 3, none had overt hypothyroidism, 3 (23.1%) had subclinical hypothyroidism and 1 (7.7%) had sick euthyroidism. No one had isolated low FT4 levels. The mean TSH level in Stage 3 was  $4.54 \pm 3.65$  mIU/L. In Stage 4, there were 39 patients, out of whom 2 (5.1%) had overt hypothyroidism, 5 (12.8%) had subclinical hypothyroidism, 2 (5.1%) had isolated low FT4 levels and 15 (38.5%) had sick euthyroidism. The mean TSH level in Stage 4 was  $3.95 \pm 3.01$  mIU/L.

The prevalence of hypothyroidism was found to be more in Stage 4 and majority of patients had sick euthyroidism. This may be related to the presence of opportunistic infections or may be the effect of HAART. Also, the number of patients showing subclinical hypothyroidism went on increasing from stage I to stage IV. On correlating the levels of FT3, FT4 and TSH with WHO clinical stage of infection, it was found that FT3 ( $p = 0.00$ ) and FT4 ( $p = 0.05$ ) levels decreased progressively from Stage I to Stage IV, meaning there is a direct correlation between FT3 and FT4 levels and stage of infection. But the correlation between TSH levels and stage of infection was not found to be significant ( $p = 0.384$ ). This is probably due to the small sample size of our study.

There are very few studies correlating stage of infection and thyroid function abnormalities. Quirino et al had found no correlation between stage of infection and thyroid function abnormalities.<sup>11</sup> In present study, a direct correlation was found between CD4 count and FT3 and FT4 levels and an inverse correlation between CD4 count and TSH levels. Out of these three parameters, correlation between FT3 and TSH levels with CD4 count was found to be significant. It means that as CD4 count goes on decreasing, there is decrease in FT3 levels ( $r=0.3079$  and  $p=0.0072$ ) and rise in TSH levels ( $r=-0.2561$  and  $p = 0.0266$ ).

Beltran et al, in their study, also concluded that low CD4 was associated with hypothyroidism and that FT3 and FT4 decreased as asymptomatic HIV infection progressed to AIDS.<sup>1</sup> Jain et al had similar observations in their study.<sup>14</sup> However, they observed that the direct correlation between FT4 levels and CD4 counts too was significant, which was not the case in our study.<sup>14</sup> An increased prevalence of abnormal thyroid function tests, in particular subclinical hypothyroidism, have been reported in both adults and children on HAART.<sup>4,12,13,15</sup> In present study, out of the total 75 patients, 39 patients were receiving HAART and 36 were naïve to HAART.

Out of the 39 patients who were receiving HAART, overt hypothyroidism was seen in 1 (2%) patient. Subclinical hypothyroidism was seen in 9 (23%) patients. Isolated low FT4 was seen in 1 (3%) patient and sick euthyroidism was seen in 7 (18%) patients. 21 (54%) were found to be euthyroid. Out of 36 patients who were naïve to HAART, 1 (3%) had overt hypothyroidism, subclinical hypothyroidism was found in 1 (3%) patient, isolated low FT4 was found in 1(3%) patient and sick euthyroidism was found in 12 (36%) patients. 18 (55%) patients were euthyroid.

Hence, it was observed that patients who were receiving HAART had a higher prevalence of subclinical hypothyroidism as compared to patients' naïve to HAART. Out of the 10 patients showing overt and subclinical hypothyroidism, Zidovudine and Stavudine

were present in the regime of 3 (30%) patients each and Tenofovir was present in the regime of 4 (40%) patients. Lamivudine and Nevirapine were present in the regime of all the 10 (100%) patients. In univariate analysis, none of the individual drug was found to be significantly associated with hypothyroidism.

Maddedu G and Calza in separate studies, have reported findings similar to ours.<sup>2,4</sup> However, Maddedu et al stated that prolonged treatment with stavudine was associated with significantly lower FT4 levels.<sup>2</sup> The cumulative daily dose of both stavudine and lamivudine was significantly related to the presence of hypothyroidism in Grappin's series.<sup>13</sup>

The role of HAART was confirmed by a recent report that interruption of HAART was associated with a normalization of thyroid function tests.<sup>2</sup> Also, it has been found that the immune reconstitution syndrome is associated with autoimmune thyroid disease. Chen estimated the prevalence of immune reconstitution Autoimmune Thyroid Disease (AITD) (Graves' disease, hashitoxicosis, and hypothyroidism) to be 3% for women and 0.2% for men. The median duration of immune reconstitution was 17 months.<sup>16-18</sup> Patients with lower CD4 counts at baseline, who experienced greater increments in the CD4 counts following HAART, were more likely to develop AITD. But none of the patients in our study was found to have immune reconstitution syndrome. Also, none of the patients were hyperthyroid.

Thyroid dysfunction in HIV-positive individuals can result from gland destruction by opportunistic pathogens (pneumocystis jirovecii or cytomegalovirus). In our study, 47 patients presented with OIs. Majority of the patients i.e., 26 (55.3%) presented with pulmonary or extrapulmonary tuberculosis, 3 (6.4%) patients had pneumocystis jirovecii pneumonia, 4 (8.5%) presented with cryptococcal meningitis, 2 (4.3%) had CNS toxoplasmosis and 9 (19.1%) presented with bacterial infections.

Out of the 26 patients who presented with tuberculosis (pulmonary / extrapulmonary / disseminated), 12 (46.2%) patients had sick euthyroidism and only 2 (7.7%) had subclinical hypothyroidism. Out of the 3 patients who had Pneumocystis jirovecii pneumonia (PCP), 1 (33.3%) had subclinical hypothyroidism and 1(33.3%) had sick euthyroidism. Out of the 4 patients who had cryptococcal meningitis, 2 (50%) had subclinical hypothyroidism and 1 (25%) had sick euthyroidism. Cryptococcal meningitis was found to be associated with subclinical hypothyroidism. CNS toxoplasmosis was found to be associated with isolated low FT4 levels. However, our sample size was too small to derive any meaningful conclusion.

Our study had certain limitations. Firstly, due to its cross sectional nature, this study is limited in terms of deriving mechanistic conclusions. Secondly, as this study is

conducted in a tertiary care hospital, the study group does not show the population characteristics and the patients in the study could not be equally distributed for HIV associated conditions like stage of infection, CD4 count, HAART, etc. Thirdly, TFT was measured at one point in time, limiting the robustness of the relationship being considered between the variable and thyroid function tests. Last limitation relates to the sample size for some variables like opportunistic infections which was too small to draw any meaningful conclusion.

## CONCLUSION

Abnormal thyroid function test results are common among HIV-infected individuals. Currently, there is insufficient evidence in favor of screening for thyroid abnormalities among asymptomatic HIV-infected individuals. Patients on HAART have high prevalence of subclinical hypothyroidism as compared to patients' naïve to HAART. Hence, patients on HAART may need regular monitoring of thyroid function tests. Larger studies are needed to examine the epidemiology and health consequences of mild thyroid dysfunction in HIV-infected patients and to better inform screening and treatment guidelines.

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