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Assessment of Amplitude of Accommodation (A.A) And Intraocular Pressure (IOP) Among Immunocompromised Subjects Taking Antiretroviral Drugs (ARV)

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Abstract-

Background/Aim: *The eye is a common site of manifestation of systemic diseases, particularly in immunocompromised individuals. Human immunodeficiency Virus (HIV) infection and its treatment with antiretroviral drugs (ARVs) have been associated with ocular changes, including variations in amplitude of accommodation (A.A) and intraocular pressure (IOP). While antiretroviral therapy (ART) has significantly improved survival, its long-term ocular effects remain underexplored.*

Methods: *A hospital-based study was conducted among 102 HIV-positive subjects on first-line and second-line ART regimens. Convenience Sampling method was utilized to obtain data from these subjects at Imo State Specialist Hospital Umuguma Owerri Imo State and General Hospital Awo Omama Imo State. Standard optometric techniques were used to measure amplitude of accommodation (A.A), while non-contact tonometry was employed to assess intraocular pressure. Sociodemographic and clinical data were collected, using informed consent and case record reviews. Data were analysed using T-test.*

Results: *The mean amplitude of accommodation was 7.62D among subjects on first-line ARV and 9.61D among those on second-line ARV, with no significant difference between the two groups and with P value = 1.00. The mean intraocular pressure was 21.30mmHg for first-line and 20.80mmHg for second-line ARV groups, showing a significant variation with P value of 0.001. There was no difference in A.A between immunocompromised subjects taking ARV1 and ARV2. There was a difference in IOP between immunocompromised subjects taking ARV1 and ARV2.*

Discussion: *The study assessed the amplitude of accommodation (A.A) and intraocular pressure (IOP) among immunocompromised subjects taking antiretroviral drugs (ARVs). Immunocompromised subjects on first-line ARV (ARV1) and those on second-line ARV (ARV2) show no difference in A.A. Their A.A is more likely to be affected by age, systemic health status and ocular comorbidities than the ARV they are taking. ART itself does not appear to exert a direct pharmacological effect on the accommodative apparatus of the eye. However, there is a difference in IOP between immunocompromised subjects taking ARV1 drugs and those taking ARV2 drugs. This difference in IOP is closely associated with the drug regimen or type of therapy. Protease inhibitors in second line drugs (ARV2) tend to cause increase in IOP. Lower or stable IOP levels among subjects on first-line ART is possibly due to a lesser impact on aqueous outflow.*

Conclusion: *Immunocompromised individuals on ART exhibit measurable changes in both amplitude of accommodation and intraocular pressure. The study concluded that there was no difference in A.A between immunocompromised subjects taking first line ARV drugs and those taking second line ARV drugs. The study also highlights that there is a difference in intraocular pressure between imunocompromised subjects taking first line ARV drugs (ARV1) and those taking second line ARV drugs (ARV2). These findings highlight the need for regular ocular assessments in HIV-positive patients receiving long-term ART to prevent potential visual impairment and improve quality of life.*

Keywords: *Antiretroviral drugs, Human Immunodeficiency virus (HIV), Amplitude of Accommodation, Intraocular pressure.*

I. INTRODUCTION

Antiretroviral drugs are used to treat HIV infection. They work by blocking a stage of the virus's life cycle and, by doing so, prevent the virus from replicating (Myhre and Sifris, 2021). Antiretroviral drugs do not cure HIV (human immunodeficiency virus) infection; they only temporarily suppress viral replication and improve symptoms (Obi, 2008). Patients receiving these drugs require careful

monitoring by appropriately trained health professionals in an adequately resourced setting. Rigorous promotion of measures to prevent new infections remains essential and its need is not diminished by the availability of antiretroviral drugs. Effective therapy requires the simultaneous use of 3 or 4 drugs; alternative regimens are necessary to meet specific requirements at start-up, to substitute for first-line regimens in cases of intolerance, or to replace failing regimens (Obi, 2008). The use of a 3 or 4 drug combination as specified in the WHO treatment guidelines is recommended (Obi, 2008). Fixed-dose preparations for some drug combinations are available; their use is recommended if the pharmaceutical quality is assured and interchangeability with the single products is demonstrated as specified by the relevant drug regulatory authority.

There are three main groups: reverse transcriptase inhibitors, protease inhibitors, and non-nucleoside reverse transcriptase inhibitors (Broder *et al,* 2008). Drugs from different groups are often used in combination. New antiretroviral drugs such as fusion inhibitors, are being developed to treat resistant forms of HIV (Broder *et al,* 2008). Antiretroviral drugs can have a range of side effects, including nausea, vomiting, diarrhea, tiredness, and a range of effects on blood chemistry, particularly involving fats.

Antiretroviral therapy is recommended as soon as possible for all individuals with HIV who have detectable viremia (Saag *et al,* 2020). Most patients can start with a 3-drug regimen or now a 2-drug regimen, which includes an integrase strand transfer inhibitor. Effective options are available for patients who may be pregnant, those who have specific clinical conditions, such as kidney, liver, or cardiovascular disease, those who have health opportunistic diseases, or those who have health care access issues (Saag *et al,*2020). For individuals at risk for HIV, preexposure prophylaxis with an oral regimen is recommended or, pending approval by regulatory bodies and availability, with a long-acting injection given every 8 weeks. Monitoring before and during therapy for effectiveness and safety is recommended. Switching therapy for virological failure is relatively rare at this time, and the recommendations for switching therapies for convenience and for other reasons are included. With the survival benefits provided by therapy, recommendations are made for older individuals with HIV.

Treatment is aimed at reducing the plasma viral load as much as possible and for as long as possible; it should be started preferably before the immune system is irreversibly damaged and before the onset of clinical immunodeficiency. The need for early drug treatment should, however, be balanced against the development of toxicity. Commitment to treatment and strict adherence over many years are required; the regimen chosen should take into account convenience and the patient's tolerance of it. The development of resistance is reduced by using a combination of 3 or 4 drugs: such combinations should have additive or synergistic activity while ensuring that their toxicity is not additive (Obi, 2008).Combination antiretroviral therapy (ART) has been universally recommended for HIV infection owing to its beneficial effects on the replication and transmission control of HIV (Bai *et al,*2020).

Women of childbearing age receiving antiretroviral therapy must have available effective contraceptive methods to prevent unintended pregnancy. Women who are taking non-nucleoside reverse transcriptase inhibitors or protease inhibitors which can lower blood concentration of hormonal oral contraceptives, should be advised to use additional or alternative contraceptives (Obi, 2008).

Classes of antiretroviral drugs include: Nucleoside reverse transcriptase inhibitors, Non-nucleoside reverse transcriptase inhibitors, Protease inhibitors, and Fixed-dose combinations. To treat HIV, experts recommend combination antiretroviral therapy (cART). It usually involves two or more drugs from these classes: NRTI- nucleoside reverse transcriptase inhibitors, NNRTI- non-nucleoside reverse transcriptase inhibitors, INSTI- integrase strand transfer inhibitors, PI- protease inhibitors.

II. MATERIALS AND METHODS

The research was a clinical study conducted on 102 HIV-positive subjects taking antiretroviral drugs, who presented to the heart to heart clinic in Imo State Specialist hospital Umuguma Owerri and General Hospital Awo Omama between May to November 2024. The immunocompromised subjects were between the ages of twenty (20) – thirty five (35) years. Convenience Sampling method was used to

obtain the subjects and the assessment of two antiretroviral drugs (ARV) on amplitude of accommodation (A.A) and intraocular pressure (IOP) of the immunocompromised subjects were compared.

The sample size was determined using Fischer's formular for sample size determination. Ethical consent was obtained from the Ethical Committee of School of Health Technology through the Department of Optometry, Federal University of Technology, Owerri, Imo State. Informed consent by the subjects was also obtained prior to the tests. The subjects were free from diabetes, hypertension and other systemic diseases such as hyperthyroidism/Graves' disease (thyroid eye disease), rheumatoid arthritis, Sjogren's syndrome, multiple sclerosis, systemic lupus erythematosus, syphilis, and neurofibromatosis, capable of affecting their ocular or visual status, as indicated on their clinical folders. They were also free from ocular diseases such as cataracts, glaucoma, refractive errors, macular degeneration, diabetic retinopathy, retinal detachment, amblyopia, strabismus, keratoconus and blepharitis. The materials used for this study include: CT Lightbox Handheld Non-contact Tonometer, Feliscope model Binocular Vision Tester (BVT), Moko Methylated Spirit, Cotton wool (swab), Topical antibiotic (Elisca Chloramphenicol), BVT tester card (Feliscope model), Heine ophthalmoscope, Trial lens box, Distant Snellen's chart and near chart. Collection of data for this research work was carried out in the following stages: the sample or research population for this study are immunocompromised subjects who were taking either of the two antiretroviral drugs (ARV). The subjects report to the heart to heart clinic at Imo State Specialist Hospital Umuguma Owerri, for their treatment on Mondays and Thursdays every week, and at General Hospital Awo Omama on Thursdays. The research was carried out on them immediately after consultation with their physicians, and with the help of the heart to heart clinic nurses and personel who also counselled them prior to the tests.

The instruments used in conducting this experiment were prepared in the following manner. The tonometer to be used for measuring the intraocular pressure (IOP) on the subjects was sterilized before and after use on each subject, using a cotton wool swab soaked with methylated spirit. A drop of antibiotic was instilled in the eyes of each subject after tonometry, as antibiotic prophylaxis. The binocular vision tester (BVT) was mounted on top of a table or desk and ready to be used on each subject. The subjects after consultation with their doctor were asked to sit for a few non-invasive ocular tests. These tests or procedures were explained to them, thereby reassuring them and getting their co-operation or consent. Their visual acuity (V.A) were assessed and their refractive errors if any, were corrected prior to the tests. This was followed by ophthalmoscopy to rule out possible ocular disease(s). Data was analyzed using the independent Sample T-test.

MEASUREMENT OF AMPLITUDE OF ACCOMMODATION

The subjects were asked to sit in front of the BVT tester and the BVT tester card was inserted on the instrument. The subject was further asked to read the accommodative target on the BVT tester card. As the card was slowly brought in towards the subject from a distance of 40cm, he was to report when the target appeared blurry. The distance at which the blur occurred was noted from the BVT tester, which has calibrations. At this same point, the amplitude of accommodation (AA) can also be read off on the instrument.

MEASUREMENT OF INTRAOCULAR PRESSURE

Determination of the AA was then followed by IOP measurement in the subjects using the non-contact tonometer. The non-contact tonometer is a digital device that measures the intraocular pressure in millimeters of mercury, by emitting a puff of air. It is an automated instrument. The subject was made to comfortably sit infront of the device and by maintaining fixation through the instrument, it automatically emits a puff of air as the mires in the instrument became sharply focused, thereby digitally recording the intraocular pressure (IOP) in millimeters of mercury (mmHg). The non-contact tonometer does not make direct contact with the eyes but can be sterilized or wiped with a cotton wool swab of methylated spirit or bleach immediately after use on each subject. The non-contact tonometer applanates the cornea by a jet of air, so there is no direct contact between the device and the surface of the eye. This theoretically avoids the need to sterilize the instrument, but the parts of the non-contact tonometer that made contact with the subjects were

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sterilized. The force of the air jet increases rapidly and linearly with time. The instrument also emits a collimated beam of light that is reflected from the central cornea and then received by a photocell. When an area of the cornea 3.6mm in diameter is flattened, the light reflected to the photocell is at a maximum. The time required to produce the peak reflection is directly related to the force of the air jet and thus to the counterbalancing IOP. The non-contact tonometer is useful for screening programs because it can be operated by non-medical personnel, it does not absolutely require topical anaesthesia. The IOP readings obtained with the non-contact tonometer correlate fairly well with readings taken by Goldmann tonometry, but differences of several millimeters of mercury are not unusual, particularly with pressures higher than the low 20s. The tonometer can be used without topical anaesthesia, but it is more accurate with anaesthesia. The patients were warned that the air puff can be startling, even after topical anaesthetic. The non-contact tonometer measures IOP over very short intervals, so it is important to average a series of readings. The instrument has an internal calibration system. The newer breed of units seem to be more comfortable for patients as well as improving the accuracy (at least as compared to Goldmann applanation tonometry (GAT)). In general, at least three but preferably four readings were obtained on each eye. The measured IOP was then estimated to be normal or high. A drop of topical antibiotic was instilled into the subjects' eyes to prevent infection. This is otherwise known as antibiotic prophylaxis.

Upon completion of these two procedures (IOP and AA measurement or determination), data obtained from the various subjects whether on first line or second line therapy, were analyzed in comparison.

III. RESULTS

The study was a clinical based study comprising of 102 subjects; 36 of them were males while the remaining 66 were females. All participants were between the ages of 20-35 years.

Table 1: Age and Gender Distribution of the subjects

Age	Male		Female		Total	
	n	%	N	%	N	%
20-25	5	4.90	7	6.86	12	11.76
26-30	11	10.78	27	26.47	38	37.25
31-35	20	19.61	32	31.37	52	50.98
Total	36	35.29	66	64.7	102	99.99

n = frequency, % = percentage frequency

Table 2: Distribution of Amplitude of Accommodation (A.A) among the subjects

A.A	N	Mean	Standard deviation (S.D)
4.01-6.00	17	5.35	0.51
6.01-8.00	30	7.48	0.49
8.01-10.00	30	9.09	0.58
10.01-12.00	16	11.08	0.64
12.01-14.00	9	12.36	0.21

Table 3: Distribution of IOP among the subjects

IOP	N	Mean	Standard deviation (S.D)
10-15	8	14.00	0.00
16-20	99	18.45	1.32
21-25	70	22.63	1.43
26-30	24	27.38	1.21
31-35	1	-	-
36-40	-	-	-
41-45	2	41	0

Table 4: Comparison of A.A among subjects taking first line ARV and second line ARV.

ARV	N	Minimum	Maximum	Mean	Standard deviation (S.D)
ARV 1	52	4.6	12.5	7.62	1.99
ARV 2	50	6	12.6	9.61	1.88

Table 5: Comparison of IOP among subjects taking first line ARV and second line ARV

ARV	N	Minimum	Maximum	Mean	Standard deviation (S.D)
ARV 1	104	14.0	41.0	21.30	5.03
ARV 2	100	16.0	29.0	20.80	2.96

IV. DISCUSSION

The results of this study showed there is no difference in Amplitude of Accommodation between immunocompromised subjects taking first line ARV drugs and those taking second line ARV drugs. Findings from the study using the independent sample T-test at 0.05 level of significance revealed a P value of 1.00. Since P (1.00) >0.05, this indicates that there is no difference in Amplitude of Accommodation between immunocompromised subjects taking first line ARV and those taking second line ARV. The absence of a significant difference in A.A aligns with the idea suggesting that antiretroviral medications may not directly impair accommodative function. Rather, changes in A.A are more strongly associated with age, systemic health status, and ocular comorbidities than with ART regimen. This indicates that accommodative ability may remain relatively preserved among HIV-positive individuals receiving treatment, provided they do not have concurrent ocular pathology or advanced age-related decline.

Also, the results of this study showed there is a difference in Intraocular pressure between immunocompromised subjects taking first line ARV drugs and those taking second line ARV drugs. Findings from this study revealed a P value of 0.001. Since P (0.001) <0.05, the alternate is accepted. This indicates there is a difference in Intraocular pressure between immunocompromised subjects taking first line ARV drugs and those taking second line ARV drugs. This is seen from the mean IOP of the subjects. IOP in HIV seems more tightly linked to degree of immunosuppression (CD4) and ocular comorbidities (e.g, CMV retinitis, uveitis) than to regimen line per se. Reduction in T-lymphocyte count in HIV infection is accompanied by a decrease in IOP in both CMV-infected and non-CMV-infected eyes, and immune recovery is associated with an increase in IOP. The observed variations in IOP between subjects on different ART regimens highlight the ocular effects of long-term therapy. Protease inhibitors often found in second-line regimens, may influence aqueous humor dynamics through metabolic alterations, steroid-like effects, or increased risk of ocular hypertension. Elevated IOP in such patients could predispose them to glaucomatous changes if not adequately monitored. Conversely, lower or stable IOP levels among subjects on first-line ART, is possibly due to a lesser impact on aqueous outflow. Overall, the results suggest that while amplitude of accommodation remains largely unaffected by ART regimen, intraocular pressure is influenced by the type of therapy, warranting closer surveillance for early detection of ocular complications.

V. CONCLUSION

This study reveals that the first line ARVs (ARV1) and the second line ARV drugs (ARV2) do not affect the amplitude of accommodation (A.A) of the subjects taking these antiretroviral drugs, while there is a difference in Intraocular pressure (IOP) between immunocompromised subjects taking first line ARV drugs and those taking second line ARV drugs.

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