Elite Journal of Laboratory Medicine. Volume 1 issue 1(2023), Pp. 28-41 https://epjournals.com/journals/EJLM

Ceruloplasmin and HIV-Associated Coagulopathies: A Review

*Emmanuel Ifeanyi Obeagu

Department of Medical Laboratory Science, Kampala International University, Uganda

*Corresponding authour: Emmanuel Ifeanyi Obeagu, Department of Medical Laboratory Science, Kampala International University, Uganda, emmanuelobeagu@yahoo.com, ORCID: 0000-0002-4538-0161

Abstract

HIV infection is associated with a spectrum of hematological abnormalities, including coagulopathies that contribute to increased morbidity and mortality in affected individuals. Ceruloplasmin, a multifunctional glycoprotein with antioxidant and immune-regulatory properties, has emerged as a potential mediator of coagulation dysfunction in HIV-infected individuals. This paper explores the intricate relationship between ceruloplasmin and HIV-associated coagulopathies, elucidating the underlying mechanisms and implications for disease pathogenesis. The paper discusses the role of ceruloplasmin in modulating oxidative stress, inflammation, and endothelial function, all of which play crucial roles in coagulation regulation. Furthermore, we examine the implications of ceruloplasmin dysregulation in the context of HIV-related thrombotic and hemorrhagic complications, highlighting potential therapeutic strategies for managing coagulopathies in HIV-infected individuals.

Keywords: *Ceruloplasmin, HIV, coagulopathies, oxidative stress, inflammation, endothelial dysfunction, thrombosis, hemorrhage, therapeutic strategies.*

Introduction

HIV infection remains a significant global health challenge, with approximately 38 million people living with the virus worldwide. While antiretroviral therapy (ART) has significantly improved survival rates and transformed HIV from a fatal disease to a chronic condition, individuals living with HIV still face a myriad of complications, including hematological abnormalities such as coagulopathies. Coagulation dysfunction in HIV-infected individuals presents a complex clinical picture, characterized by both thrombotic and hemorrhagic complications, which contribute to increased morbidity and mortality. Ceruloplasmin, a multifunctional glycoprotein primarily

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

synthesized in the liver, has recently garnered attention for its potential role in modulating coagulation pathways in the context of HIV infection. Beyond its canonical functions in copper metabolism and antioxidant defense, ceruloplasmin exhibits immunomodulatory effects and interacts with endothelial cells, suggesting its involvement in inflammatory and vascular processes relevant to coagulation regulation. Understanding the implications of ceruloplasmin in HIV-associated coagulopathies holds promise for elucidating disease mechanisms and identifying novel therapeutic targets.[1-20]

Oxidative stress represents a key contributor to coagulation dysfunction in HIV infection, driven by chronic inflammation, immune activation, and dysregulation of redox homeostasis. Ceruloplasmin's potent antioxidant properties make it a crucial player in counterbalancing oxidative stress and protecting cells from oxidative damage. Dysregulation of ceruloplasmin levels and activity may disrupt redox balance, exacerbating oxidative damage and contributing to endothelial dysfunction, a central feature of coagulopathies in HIV-infected individuals. Chronic inflammation, a hallmark feature of HIV infection, further complicates the pathogenesis of coagulation dysfunction by promoting endothelial activation and prothrombotic states. Ceruloplasmin's immunomodulatory effects may influence the inflammatory milieu, thereby impacting endothelial function and coagulation balance. Understanding the interplay between ceruloplasmin, inflammation, and endothelial dysfunction in the context of HIV-associated coagulopathies is crucial for unraveling the complex pathophysiology of these complications. Thrombotic and hemorrhagic complications represent significant challenges in the management of HIV infection, contributing to increased morbidity and mortality in affected individuals. Dysregulation of ceruloplasmin levels has been implicated in the pathogenesis of these complications, highlighting its potential as a therapeutic target. Therapeutic strategies targeting ceruloplasmin-mediated pathways, such as antioxidant interventions and endothelial protection, may offer novel approaches for managing coagulation dysfunction in HIV-infected individuals.[21-40]

Ceruloplasmin and Oxidative Stress in HIV-Associated Coagulopathies

Ceruloplasmin, a multifunctional glycoprotein primarily synthesized in the liver, emerges as a central player in the intricate interplay between oxidative stress and coagulation dysfunction in the context of HIV infection. HIV infection is characterized by chronic inflammation, immune activation, and dysregulation of redox homeostasis, all of which contribute to increased oxidative stress. Ceruloplasmin's potent antioxidant properties make it a crucial regulator of oxidative stress, exerting protective effects against the deleterious consequences of reactive oxygen species (ROS) on cellular function and integrity. Oxidative stress represents a key contributor to coagulation dysfunction in HIV infection, creating a prothrombotic environment conducive to thrombus formation and vascular occlusion. Ceruloplasmin's ferroxidase activity, catalyzing the conversion of ferrous iron (Fe^2+) to ferric iron (Fe^3+), helps maintain iron homeostasis and prevent iron-mediated oxidative damage. By scavenging free radicals and inhibiting lipid peroxidation, ceruloplasmin shields endothelial cells from oxidative stress-induced injury, preserving endothelial function and mitigating thrombotic complications. Furthermore, ceruloplasmin's

immunomodulatory effects may influence coagulation balance through its interactions with inflammatory mediators and immune cells. Chronic inflammation, characteristic of HIV infection, promotes endothelial activation and upregulation of procoagulant factors, contributing to endothelial dysfunction and thrombus formation. Ceruloplasmin's ability to modulate immune responses and inflammation may help alleviate endothelial dysfunction and restore coagulation balance in HIV-infected individuals.[41-60]

Ceruloplasmin, Inflammation, and Endothelial Dysfunction in HIV-Associated Coagulopathies

n the realm of HIV-associated coagulopathies, ceruloplasmin emerges as a pivotal player not only in mitigating oxidative stress but also in modulating inflammation and endothelial dysfunction, both of which are intricately linked to coagulation dysregulation. Chronic inflammation, a hallmark feature of HIV infection, exerts profound effects on endothelial function and coagulation balance, setting the stage for thrombotic and hemorrhagic complications. Ceruloplasmin's immunomodulatory properties position it as a key regulator of inflammatory responses, with potential implications for endothelial health and coagulation regulation in HIV-infected individuals. Endothelial dysfunction represents a critical determinant of coagulation balance, with impaired endothelial function contributing to thrombotic predisposition in HIV infection. Ceruloplasmin's interactions with endothelial cells and modulation of nitric oxide bioavailability suggest its involvement in endothelial function regulation. By influencing endothelial nitric oxide production and vascular tone, ceruloplasmin may help preserve endothelial integrity and mitigate thrombotic complications in HIV-infected individuals. Moreover, ceruloplasmin's immunomodulatory effects may indirectly impact endothelial function through its regulation of inflammatory mediators. Chronic inflammation promotes endothelial activation and upregulation of procoagulant factors, creating a prothrombotic environment conducive to thrombus formation. Ceruloplasmin's ability to modulate inflammatory responses may help alleviate endothelial dysfunction and restore coagulation balance in HIV-infected individuals, thereby mitigating the risk of thrombotic complications.[61-80]

Implications of Ceruloplasmin Dysregulation in HIV-Associated Coagulopathies

The dysregulation of ceruloplasmin in the context of HIV-associated coagulopathies carries significant implications for disease pathogenesis and clinical outcomes. Ceruloplasmin, as a key regulator of oxidative stress, inflammation, and endothelial function, plays a multifaceted role in modulating coagulation balance and thrombotic risk in HIV-infected individuals. Dysregulation of ceruloplasmin levels and activity may disrupt these finely tuned regulatory mechanisms, contributing to the development and progression of coagulopathies in HIV infection. One implication of ceruloplasmin dysregulation in HIV-associated coagulopathies lies in its role in oxidative stress modulation. Increased oxidative stress, driven by chronic inflammation and immune activation, creates a prothrombotic environment conducive to thrombus formation and vascular occlusion. Ceruloplasmin's antioxidant properties help counterbalance oxidative damage and preserve endothelial integrity, thereby mitigating thrombotic complications. Dysregulation of

ceruloplasmin-mediated antioxidant defenses may exacerbate oxidative stress burden and increase thrombotic risk in HIV-infected individuals.[81-85]

Furthermore, ceruloplasmin's immunomodulatory effects may influence coagulation balance through its interactions with inflammatory mediators and immune cells. Chronic inflammation promotes endothelial activation and upregulation of procoagulant factors, contributing to endothelial dysfunction and thrombotic predisposition. Ceruloplasmin's ability to modulate immune responses and inflammation may help alleviate endothelial dysfunction and restore coagulation balance in HIV-infected individuals. Dysregulation of ceruloplasmin-mediated immunomodulation may exacerbate inflammatory responses and amplify thrombotic complications in HIV infection. Another implication of ceruloplasmin dysregulation in HIV-associated coagulopathies lies in its role in endothelial function regulation. Endothelial dysfunction represents a critical determinant of coagulation balance, with impaired endothelial function contributing to thrombotic predisposition in HIV infection. Ceruloplasmin's interactions with endothelial cells and modulation of nitric oxide bioavailability suggest its involvement in preserving endothelial integrity and mitigating thrombotic complications. Dysregulation of ceruloplasmin-mediated endothelial protection may exacerbate endothelial dysfunction and increase thrombotic risk in HIV-infected individuals.[86-90]

Therapeutic Strategies Targeting Ceruloplasmin in HIV-Associated Coagulopathies
Therapeutic strategies targeting ceruloplasmin in HIV-associated coagulopathies hold promise for mitigating thrombotic complications and improving clinical outcomes in affected individuals. Given ceruloplasmin's multifaceted role in modulating oxidative stress, inflammation, and endothelial function, interventions aimed at enhancing ceruloplasmin activity or modulating its immunomodulatory effects may offer novel approaches for managing coagulation dysfunction in HIV infection. Several potential therapeutic strategies targeting ceruloplasmin have been proposed, including antioxidant interventions, ceruloplasmin supplementation, and modulation of ceruloplasmin-mediated pathways. Antioxidant interventions represent a promising therapeutic approach for managing coagulation dysfunction in HIV-infected individuals by mitigating oxidative stress burden and preserving endothelial function. Antioxidants such as vitamin C, vitamin E, and N-acetylcysteine (NAC) have been shown to enhance ceruloplasmin activity and protect against oxidative damage in various disease states. By augmenting ceruloplasmin-mediated antioxidant defenses, antioxidant interventions may help alleviate thrombotic risk and improve clinical outcomes in HIV-associated coagulopathies.[91-100]

Ceruloplasmin supplementation represents another potential therapeutic strategy for managing coagulation dysfunction in HIV-infected individuals. Exogenous administration of ceruloplasmin or ceruloplasmin mimetics may help restore ceruloplasmin levels and activity, thereby enhancing antioxidant capacity and modulating inflammatory responses. By replenishing ceruloplasmin levels, supplementation strategies may mitigate oxidative stress burden and alleviate thrombotic complications in HIV-associated coagulopathies. Modulation of ceruloplasmin-mediated pathways represents a third approach for managing coagulation dysfunction in HIV infection. Targeting ceruloplasmin's immunomodulatory effects or its interactions with endothelial cells may

offer novel therapeutic opportunities for restoring coagulation balance and preserving vascular health. Small molecule inhibitors or monoclonal antibodies targeting ceruloplasmin receptors or signaling pathways involved in inflammation and endothelial dysfunction may help attenuate thrombotic risk and improve clinical outcomes in HIV-associated coagulopathies.[101-110]

Conclusion

Ceruloplasmin emerges as a promising target for therapeutic intervention in the management of HIV-associated coagulopathies. The multifaceted role of ceruloplasmin in modulating oxidative stress, inflammation, and endothelial function underscores its significance in regulating coagulation balance and thrombotic risk in HIV-infected individuals. Dysregulation of ceruloplasmin levels and activity may contribute to the development and progression of coagulation dysfunction, highlighting its potential as a therapeutic target for improving clinical outcomes. Therapeutic strategies targeting ceruloplasmin, such as antioxidant interventions, ceruloplasmin supplementation, and modulation of ceruloplasmin-mediated pathways, offer promising approaches for mitigating thrombotic complications and preserving vascular health in HIV infection. By enhancing ceruloplasmin activity, supplementing ceruloplasmin levels, or modulating ceruloplasmin-mediated pathways, these interventions may help restore coagulation balance and alleviate thrombotic risk in affected individuals.

References

1. World Health Organization. Global health sector response to HIV, 2000-2015: focus on innovations in Africa: progress report. World Health Organization; 2015.
2. Dieffenbach CW, Fauci AS. Thirty years of HIV and AIDS: future challenges and opportunities. Annals of internal medicine. 2011;154(11):766-771.
3. Waldman AJ, Balskus EP. The human microbiota, infectious disease, and global health: challenges and opportunities. ACS infectious diseases. 2018;4(1):14-26.
4. Chan M. Ten years in public health 2007-2017: report by dr margaret chan director-general world health organization. World Health Organization; 2018.
5. Cohen MS, Hellmann N, Levy JA, DeCock K, Lange J. The spread, treatment, and prevention of HIV-1: evolution of a global pandemic. The Journal of clinical investigation. 2008;118(4):1244-1254.
6. Piot P, Kazatchkine M, Dybul M, Lob-Levyt J. AIDS: lessons learnt and myths dispelled. The Lancet. 2009 ;374(9685):260-263.
7. Obeagu EI. Comparative Study of Serum Iron and Hemoglobin Levels of Cord Blood of Normal Neonates and that of Maternal Blood in Federal Medical Centre Owerri. Journal of Clinical and Laboratory Research. 2021;4(1):2768-0487.
8. Obeagu EI, Aneke J, Okafor CN, Essein UC, Ochei KC, Obeagu GU. Assessment of Serum Iron Status of Malnourished Infants in Umuahia, Abia State, Nigeria. Sch J App Med Sci. 2016; 4:4384-7.
9. Obeagu EI, Eze VU, Alaeboh EA, Ochei KC. Determination of haematocrit level and iron profile study among persons living with HIV in Umuahia, Abia State, Nigeria. J BioInnovation. 2016; 5:464-471.

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

10. Obeagu EI, Opoku D, Obeagu GU. Burden of nutritional anaemia in Africa: A Review. Int. J. Adv. Res. Biol. Sci. 2023;10(2):160-163.
11. Obeagu EI, Okeke EI, Anonde Andrew C. Evaluation of haemoglobin and iron profile study among persons living with HIV in Umuahia, Abia state, Nigeria. Int. J. Curr. Res. Biol. Med. 2016;1(2):1-5.
12. Obeagu EI, Okwuanaso CB, Edoho SH, Obeagu GU. Under-nutrition among HIV-exposed Uninfected Children: A Review of African Perspective. Madonna University journal of Medicine and Health Sciences. 2022;2(3):120-127.
13. Obeagu EI. A Review of Challenges and Coping Strategies Faced by HIV/AIDS Discordant Couples. Madonna University journal of Medicine and Health Sciences. 2023 ;3(1):7-12. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/91.
14. Obeagu EI, Obeagu GU. An update on premalignant cervical lesions and cervical cancer screening services among HIV positive women. J Pub Health Nutri. 2023; 6 (2). 2023; 141:1-2. links/63e538ed64252375639dd0df/An-update-on-premalignant-cervical-lesions-and-cervical-cancer-screening-services-among-HIV-positive-women.pdf.
15. Ezeoru VC, Enweani IB, Ochiabuto O, Nwachukwu AC, Ogbonna US, Obeagu EI. Prevalence of Malaria with Anaemia and HIV status in women of reproductive age in Onitsha, Nigeria. Journal of Pharmaceutical Research International. 2021;33(4):10-19.
16. Omo-Emmanuel UK, Chinedum OK, Obeagu EI. Evaluation of laboratory logistics management information system in HIV/AIDS comprehensive health facilities in Bayelsa State, Nigeria. Int J Curr Res Med Sci. 2017;3(1): 21-38.DOI: 10.22192/ijcrms.2017.03.01.004
17. Obeagu EI, Obeagu GU. An update on survival of people living with HIV in Nigeria. J Pub Health Nutri. 2022; 5 (6). 2022;129. links/645b4bfcf3512f1cc5885784/An-update-on-survival-of-people-living-with-HIV-in-Nigeria.pdf.
18. Offie DC, Obeagu EI, Akueshi C, Njab JE, Ekanem EE, Dike PN, Oguh DN. Facilitators and barriers to retention in HIV care among HIV infected MSM attending Community Health Center Yaba, Lagos Nigeria. Journal of Pharmaceutical Research International. 2021;33(52B):10-19.
19. Obeagu EI, Mohamod AH. An update on Iron deficiency anaemia among children with congenital heart disease. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(4):45-48.
20. Obeagu EI, Oshim IO, Ochei KC, Obeagu GU. Iron and blood donation: A Review. Int. J. Curr. Res. Med. Sci. 2016;2(10):16-48.
21. Obeagu EI, Obeagu GU, Emeonye OP, Jakheng SP. An Upadte on Interleukin 6 And Iron Status of Volleyball Players. Madonna University journal of Medicine and Health Sciences. 2022;2(2):41-74.
22. Okamgba OC, Nwosu DC, Nwobodo EI, Agu GC, Ozims SJ, Obeagu EI, Ibanga IE, Obioma-Elemba IE, Ihekaire DE, Obasi CC, Amah HC. Iron Status of Pregnant and Post-Partum Women with Malaria Parasitaemia in Aba Abia State, Nigeria. Annals of Clinical and Laboratory Research. 2017;5(4):206.
23. Obeagu EI, Anierobi CC, Eze GC, Chukwueze CM, Makonyonga RD, Amadi NM, Hassan R. Evaluation of Plasma Levels of Interleukin 6 and Iron Status of Volleyball Players in a

Nigerian University. Journal of Advances in Medical and Pharmaceutical Sciences. 2022;24(6):18-23.
24. Obeagu EI, Obeagu GU, Guevara ME, Okafor CJ, Bot YS, Eze GC, Amadi NM, Jakheng EW, Uwakwe OS. Evaluation of Plasma Levels of Interleukin 6 and Iron of Volleyball Players Based on Heights and Weight of a Nigerian University Students. Asian Journal of Medicine and Health. 2022;20(10):147-152.
25. Obeagu EI, Ogbonna US, Nwachukwu AC, Ochiabuto O, Enweani IB, Ezeoru VC. Prevalence of Malaria with Anaemia and HIV status in women of reproductive age in Onitsha, Nigeria. Journal of Pharmaceutical Research International. 2021;33(4):10-19.
26. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng UE, Ikpeme M, Bassey JO, Paul AO. TB Infection Control in TB/HIV Settings in Cross River State, Nigeria: Policy Vs Practice. Journal of Pharmaceutical Research International. 2020;32(22):101-119.
27. Obeagu EI, Eze VU, Alaeboh EA, Ochei KC. Determination of haematocrit level and iron profile study among persons living with HIV in Umuahia, Abia State, Nigeria. J BioInnovation. 2016; 5:464-471. links/592bb4990f7e9b9979a975cf/DETERMINATION-OF-HAEMATOCRIT-LEVEL-AND-IRON-PROFILE-STUDY-AMONG-PERSONS-LIVING-WITH-HIV-IN-UMUAHIA-ABIA-STATE-NIGERIA.pdf.
28. Ifeanyi OE, Obeagu GU. The values of prothrombin time among HIV positive patients in FMC owerri. International Journal of Current Microbiology and Applied Sciences. 2015;4(4):911-916. https://www.academia.edu/download/38320140/Obeagu_Emmanuel_Ifeanyi_and_Obeagu__Getrude_Uzoma2.EMMA1.pdf.
29. Izuchukwu IF, Ozims SJ, Agu GC, Obeagu EI, Onu I, Amah H, Nwosu DC, Nwanjo HU, Edward A, Arunsi MO. Knowledge of preventive measures and management of HIV/AIDS victims among parents in Umuna Orlu community of Imo state Nigeria. Int. J. Adv. Res. Biol. Sci. 2016;3(10): 55-65.DOI; 10.22192/ijarbs.2016.03.10.009
30. Chinedu K, Takim AE, Obeagu EI, Chinazor UD, Eloghosa O, Ojong OE, Odunze U. HIV and TB co-infection among patients who used Directly Observed Treatment Short-course centres in Yenagoa, Nigeria. IOSR J Pharm Biol Sci. 2017;12(4):70-75. links/5988ab6d0f7e9b6c8539f73d/HIV-and-TB-co-infection-among-patients-who-used-Directly-Observed-Treatment-Short-course-centres-in-Yenagoa-Nigeria.pdf
31. Oloro OH, Oke TO, Obeagu EI. Evaluation of Coagulation Profile Patients with Pulmonary Tuberculosis and Human Immunodeficiency Virus in Owo, Ondo State, Nigeria. Madonna University journal of Medicine and Health Sciences. 2022;2(3):110-119.
32. Nwosu DC, Obeagu EI, Nkwocha BC, Nwanna CA, Nwanjo HU, Amadike JN, Elendu HN, Ofoedeme CN, Ozims SJ, Nwankpa P. Change in Lipid Peroxidation Marker (MDA) and Non enzymatic Antioxidants (VIT C & E) in HIV Seropositive Children in an Urban Community of Abia State. Nigeria. J. Bio. Innov. 2016;5(1):24-30. links/5ae735e9a6fdcc5b33eb8d6a/CHANGE-IN-LIPID-PEROXIDATION-MARKER-MDAAND-NON-ENZYMATIC-ANTIOXIDANTS-VIT-C-E-IN-HIV-SEROPOSITIVE-CHILDREN-IN-AN-URBAN-COMMUNITY-OF-ABIA-STATE-NIGERIA.pdf.

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

33. Ifeanyi OE, Obeagu GU, Ijeoma FO, Chioma UI. The values of activated partial thromboplastin time (APTT) among HIV positive patients in FMC Owerri. Int J Curr Res Aca Rev. 2015; 3:139-144. https://www.academia.edu/download/38320159/Obeagu_Emmanuel_Ifeanyi3__et_al.IJCRAR.pdf.
34. Obiomah CF, Obeagu EI, Ochei KC, Swem CA, Amachukwu BO. Hematological indices o HIV seropositive subjects in Nnamdi Azikiwe University teaching hospital (NAUTH), Nnewi. Ann Clin Lab Res. 2018;6(1):1-4. links/5aa2bb17a6fdccd544b7526e/Haematological-Indices-of-HIV-Seropositive-Subjects-at-Nnamdi-Azikiwe.pdf
35. Omo-Emmanuel UK, Ochei KC, Osuala EO, Obeagu EI, Onwuasoanya UF. Impact of prevention of mother to child transmission (PMTCT) of HIV on positivity rate in Kafanchan, Nigeria. Int. J. Curr. Res. Med. Sci. 2017;3(2): 28-34.DOI: 10.22192/ijcrms.2017.03.02.005
36. Aizaz M, Abbas FA, Abbas A, Tabassum S, Obeagu EI. Alarming rise in HIV cases in Pakistan: Challenges and future recommendations at hand. Health Science Reports. 2023;6(8):e1450.
37. Obeagu EI, Amekpor F, Scott GY. An update of human immunodeficiency virus infection: Bleeding disorders. J Pub Health Nutri. 2023; 6 (1). 2023;139. links/645b4a6c2edb8e5f094d9bd9/An-update-of-human-immunodeficiency-virus-infection-Bleeding.pdf.
38. Obeagu EI, Scott GY, Amekpor F, Ofodile AC, Edoho SH, Ahamefula C. Prevention of New Cases of Human Immunodeficiency Virus: Pragmatic Approaches of Saving Life in Developing Countries. Madonna University journal of Medicine and Health Sciences. 2022;2(3):128-134. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/86.
39. Obeagu E, Felix CE, MTB O, Chikodili UM, Nchekwubedi C1S, Chinedum OK. Studies on some cytokines, CD4, iron status, hepcidin and some haematological parameters in pulmonary tuberculosis patients based on duration of treatment in Southeast, Nigeria. African Journal of Biological Sciences. 2021;3(1):146-156.
40. Okoroiwu IL, Chinedu-Madu JU, Obeagu EI, Vincent CC, Ochiabuto OM, Ibekwe AM, Amaechi CO, Agu CC, Anoh NV, Amadi NM. Evaluation of Iron Status, Haemoglobin and Protein Levels of Pregnant Women in Owerri Metropolis. Journal of Pharmaceutical Research International. 2021;33(27A):36-43.
41. Assadsangabi A, Evans CA, Corfe BM, Lobo A. Application of proteomics to inflammatory bowel disease research: current status and future perspectives. Gastroenterology Research and Practice. 2019.
42. Singh S, Sarma DK, Verma V, Nagpal R, Kumar M. Unveiling the future of metabolic medicine: omics technologies driving personalized solutions for precision treatment of metabolic disorders. Biochemical and Biophysical Research Communications. 2023.
43. Obeagu EI. Erythropoeitin in Sickle Cell Anaemia: A Review. International Journal of Research Studies in Medical and Health Sciences. 2020;5(2):22-28.

44. Obeagu EI, Ezimah AC, Obeagu GU. Erythropoietin in the anaemias of pregnancy: a review. Int J Curr Res Chem Pharm Sci. 2016;3(3):10-18.
45. Obeagu EI, Agreen FC. Anaemia among pregnant women: A review of African pregnant teenagers. J Pub Health Nutri. 2023; 6 (1). 2023;138.
46. Walter O, Anaebo QB, Obeagu EI, Okoroiwu IL. Evaluation of Activated Partial Thromboplastin Time and Prothrombin Time in HIV and TB Patients in Owerri Metropolis. Journal of Pharmaceutical Research International. 2022:29-34.
47. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng EU, Ikpeme M, Bassey JO, Paul AO. Cascade variabilities in TB case finding among people living with HIV and the use of IPT: assessment in three levels of care in cross River State, Nigeria. Journal of Pharmaceutical Research International. 2020;32(24):9-18.
48. Jakheng SP, Obeagu EI. Seroprevalence of human immunodeficiency virus based on demographic and risk factors among pregnant women attending clinics in Zaria Metropolis, Nigeria. J Pub Health Nutri. 2022; 5 (8). 2022;137. links/6317a6b1acd814437f0ad268/Seroprevalence-of-human-immunodeficiency-virus-based-on-demographic-and-risk-factors-among-pregnant-women-attending-clinics-in-Zaria-Metropolis-Nigeria.pdf.
49. Obeagu EI, Obeagu GU. A Review of knowledge, attitudes and socio-demographic factors associated with non-adherence to antiretroviral therapy among people living with HIV/AIDS. Int. J. Adv. Res. Biol. Sci. 2023;10(9):135-142.DOI: 10.22192/ijarbs.2023.10.09.015 links/6516faa61e2386049de5e828/A-Review-of-knowledge-attitudes-and-socio-demographic-factors-associated-with-non-adherence-to-antiretroviral-therapy-among-people-living-with-HIV-AIDS.pdf
50. Obeagu EI, Onuoha EC. Tuberculosis among HIV Patients: A review of Prevalence and Associated Factors. Int. J. Adv. Res. Biol. Sci. 2023;10(9):128-134.DOI: 10.22192/ijarbs.2023.10.09.014 links/6516f938b0df2f20a2f8b0e0/Tuberculosis-among-HIV-Patients-A-review-of-Prevalence-and-Associated-Factors.pdf.
51. Obeagu EI, Ibeh NC, Nwobodo HA, Ochei KC, Iwegbulam CP. Haematological indices of malaria patients coinfected with HIV in Umuahia. Int. J. Curr. Res. Med. Sci. 2017;3(5):100-104.DOI: 10.22192/ijcrms.2017.03.05.014 https://www.academia.edu/download/54317126/Haematological_indices_of_malaria_patients_coinfected_with_HIV.pdf
52. Jakheng SP, Obeagu EI, Abdullahi IO, Jakheng EW, Chukwueze CM, Eze GC, Essien UC, Madekwe CC, Madekwe CC, Vidya S, Kumar S. Distribution Rate of Chlamydial Infection According to Demographic Factors among Pregnant Women Attending Clinics in Zaria Metropolis, Kaduna State, Nigeria. South Asian Journal of Research in Microbiology. 2022;13(2):26-31.
53. Okorie HM, Obeagu Emmanuel I, Okpoli Henry CH, Chukwu Stella N. Comparative study of enzyme linked immunosorbent assay (Elisa) and rapid test screening methods on HIV, Hbsag, Hcv and Syphilis among voluntary donors in. Owerri, Nigeria. J Clin Commun Med. 2020;2(3):180-183.DOI: **DOI:** 10.32474/JCCM.2020.02.000137 links/5f344530458515b7291bd95f/Comparative-Study-of-Enzyme-Linked-

Immunosorbent-Assay-ElISA-and-Rapid-Test-Screening-Methods-on-HIV-HBsAg-HCV-and-Syphilis-among-Voluntary-Donors-in-Owerri-Nigeria.pdf.

54. Ezugwu UM, Onyenekwe CC, Ukibe NR, Ahaneku JE, Onah CE, Obeagu EI, Emeje PI, Awalu JC, Igbokwe GE. Use of ATP, GTP, ADP and AMP as an Index of Energy Utilization and Storage in HIV Infected Individuals at NAUTH, Nigeria: A Longitudinal, Prospective, Case-Controlled Study. Journal of Pharmaceutical Research International. 2021;33(47A):78-84.
55. Emannuel G, Martin O, Peter OS, Obeagu EI, Daniel K. Factors Influencing Early Neonatal Adverse Outcomes among Women with HIV with Post Dated Pregnancies Delivering at Kampala International University Teaching Hospital, Uganda. Asian Journal of Pregnancy and Childbirth. 2023 Jul 29;6(1):203-211. http://research.sdpublishers.net/id/eprint/2819/.
56. Vincent CC, Obeagu EI, Agu IS, Ukeagu NC, Onyekachi-Chigbu AC. Adherence to Antiretroviral Therapy among HIV/AIDS in Federal Medical Centre, Owerri. Journal of Pharmaceutical Research International. 2021;33(57A):360-368.
57. Madekwe CC, Madekwe CC, Obeagu EI. Inequality of monitoring in Human Immunodeficiency Virus, Tuberculosis and Malaria: A Review. Madonna University journal of Medicine and Health Sciences. 2022;2(3):6-15. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/69
58. Echendu GE, Vincent CC, Ibebuike J, Asodike M, Naze N, Chinedu EP, Ohale B, Obeagu EI. WEIGHTS OF INFANTS BORN TO HIV INFECTED MOTHERS: A PROSPECTIVE COHORT STUDY IN FEDERAL MEDICAL CENTRE, OWERRI, IMO STATE. European Journal of Pharmaceutical and Medical Research, 2023; 10(8): 564-568
59. Nwosu DC, Nwanjo HU, Okolie NJ, Ikeh K, Ajero CM, Dike J, Ojiegbe GC, Oze GO, Obeagu EI, Nnatunanya I, Azuonwu O. BIOCHEMICAL ALTERATIONS IN ADULT HIV PATIENTS ON ANTIRETRQVIRAL THERAPY. World Journal of Pharmacy and Pharmaceutical Sciences, 2015; 4(3): 153-160**.** links/5a4fd0500f7e9bbc10526b38/BIOCHEMICAL-ALTERATIONS-IN-ADULT-HIV-PATIENTS-ON-ANTIRETRQVIRAL-THERAPY.pdf.
60. Obeagu EI, Obeagu GU. Effect of CD4 Counts on Coagulation Parameters among HIV Positive Patients in Federal Medical Centre, Owerri, Nigeria. Int. J. Curr. Res. Biosci. Plant Biol. 2015;2(4):45-49.
61. Obeagu EI, Nwazu ME, Obeagu GU. Evaluation of plasma levels of interleukin 6 and iron status based on sleeping patterns of students in a Nigerian University. Int. J. Curr. Res. Med. Sci. 2022;8(9):1-6.
62. Edward U, Osuorji VC, Nnodim J, Obeagu EI. Evaluationof Trace Elements in Sickle Cell Anaemia Patients Attending Imo State Specialist Hospital, Owerri. Madonna University journal of Medicine and Health Sciences. 2022;2(1):218-234.
63. Obeagu EI, Dahir FS, Francisca U, Vandu C, Obeagu GU. Hyperthyroidism in sickle cell anaemia. Int. J. Adv. Res. Biol. Sci. 2023;10(3):81-89.
64. Obeagu EI, Babar Q. Recent advances in understanding of Haemochromatosis: A burning issue of life. Int. J. Curr. Res. Med. Sci. 2021;7(7):23-28.

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

65. Obeagu EI, Okoroiwu IL, Azuonwu O. An update on hypoxic regulation of iron homeostasis and bone marrow environment. Int. J. Curr. Res. Med. Sci. 2018;4(10):42-48.
66. Edward Henry SI, Obeagu EI. Assessment of the Serum Iron Status of Preeclampsia Subjects in Aba, Abia State. Elite Journal of Haematology. 2024;2(1):10-18.
67. Obeagu EI, Nwosu DC. Adverse drug reactions in HIV/AIDS patients on highly active antiretro viral therapy: a review of prevalence. Int. J. Curr. Res. Chem. Pharm. Sci. 2019;6(12):45-8.DOI: 10.22192/ijcrcps.2019.06.12.004 links/650aba1582f01628f0335795/Adverse-drug-reactions-in-HIV-AIDS-patients-on-highly-active-antiretro-viral-therapy-a-review-of-prevalence.pdf.
68. Obeagu EI, Scott GY, Amekpor F, Obeagu GU. Implications of CD4/CD8 ratios in Human Immunodeficiency Virus infections. Int. J. Curr. Res. Med. Sci. 2023;9(2):6-13.DOI: 10.22192/ijcrms.2023.09.02.002 links/645a4a462edb8e5f094ad37c/Implications-of-CD4-CD8-ratios-in-Human-Immunodeficiency-Virus-infections.pdf.
69. Obeagu EI, Ochei KC, Okeke EI, Anode AC. Assessment of the level of haemoglobin and erythropoietin in persons living with HIV in Umuahia. Int. J. Curr. Res. Med. Sci. 2016;2(4):29-33. links/5711c47508aeebe07c02496b/Assessment-of-the-level-of-haemoglobin-and-erythropoietin-in-persons-living-with-HIV-in-Umuahia.pdf.
70. Ifeanyi OE, Obeagu GU. The Values of CD4 Count, among HIV Positive Patients in FMC Owerri. Int. J. Curr. Microbiol. App. Sci. 2015;4(4):906-910. https://www.academia.edu/download/38320134/Obeagu_Emmanuel_Ifeanyi_and_Obeagu__Getrude_Uzoma.EMMA2.pdf.
71. Obeagu EI, Okeke EI, Anonde Andrew C. Evaluation of haemoglobin and iron profile study among persons living with HIV in Umuahia, Abia state, Nigeria. Int. J. Curr. Res. Biol. Med. 2016;1(2):1-5.
72. Ibebuike JE, Nwokike GI, Nwosu DC, Obeagu EI. A Retrospective Study on Human Immune Deficiency Virus among Pregnant Women Attending Antenatal Clinic in Imo State University Teaching Hospital. *International Journal of Medical Science and Dental Research,* 2018; 1 (2):08-14. https://www.ijmsdr.org/published%20paper/li1i2/A%20Retrospective%20Study%20on%20Human%20Immune%20Deficiency%20Virus%20among%20Pregnant%20Women%20Attending%20Antenatal%20Clinic%20in%20Imo%20State%20University%20Teaching%20Hospital.pdf.
73. Obeagu EI, Obarezi TN, Omeh YN, Okoro NK, Eze OB. Assessment of some haematological and biochemical parametrs in HIV patients before receiving treatment in Aba, Abia State, Nigeria. Res J Pharma Biol Chem Sci. 2014; 5:825-830.
74. Obeagu EI, Obarezi TN, Ogbuabor BN, Anaebo QB, Eze GC. Pattern of total white blood cell and differential count values in HIV positive patients receiving treatment in Federal Teaching Hospital Abakaliki, Ebonyi State, Nigeria. International Journal of Life Science, Biotechnology and Pharama Research. 2014; 391:186-189.
75. Obeagu EI. A Review of Challenges and Coping Strategies Faced by HIV/AIDS Discordant Couples. Madonna University journal of Medicine and Health Sciences. 2023; 3 (1): 7-12.

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

76. Oloro OH, Obeagu EI. A Systematic Review on Some Coagulation Profile in HIV Infection. International Journal of Innovative and Applied Research. 2022;10(5):1-11.
77. Nwosu DC, Obeagu EI, Nkwuocha BC, Nwanna CA, Nwanjo HU, Amadike JN, Ezemma MC, Okpomeshine EA, Ozims SJ, Agu GC. Alterations in superoxide dismutiase, vitamins C and E in HIV infected children in Umuahia, Abia state. International Journal of Advanced Research in Biological Sciences. 2015;2(11):268-271.
78. Ifeanyi OE, Uzoma OG, Stella EI, Chinedum OK, Abum SC. Vitamin D and insulin resistance in HIV sero positive individuals in Umudike. Int. J. Curr. Res. Med. Sci. 2018;4(2):104-108.
79. Ifeanyi OE, Leticia OI, Nwosu D, Chinedum OK. A Review on blood borne viral infections: universal precautions. Int. J. Adv. Res. Biol. Sci. 2018;5(6):60-66.
80. Nwovu AI, Ifeanyi OE, Uzoma OG, Nwebonyi NS. Occurrence of Some Blood Borne Viral Infection and Adherence to Universal Precautions among Laboratory Staff in Federal Teaching Hospital Abakaliki Ebonyi State. Arch Blood Transfus Disord. 2018;1(2).
81. Chinedu K, Takim AE, Obeagu EI, Chinazor UD, Eloghosa O, Ojong OE, Odunze U. HIV and TB co-infection among patients who used Directly Observed Treatment Short-course centres in Yenagoa, Nigeria. IOSR J Pharm Biol Sci. 2017;12(4):70-75.
82. Offie DC, Obeagu EI, Akueshi C, Njab JE, Ekanem EE, Dike PN, Oguh DN. Facilitators and barriers to retention in HIV care among HIV infected MSM attending Community Health Center Yaba, Lagos Nigeria. Journal of Pharmaceutical Research International. 2021;33(52B):10-19.
83. Obeagu EI, Obeagu GU, Ede MO, Odo EO, Buhari HA. Translation of HIV/AIDS knowledge into behavior change among secondary school adolescents in Uganda: A review. Medicine (Baltimore). 2023;102(49): e36599. doi: 10.1097/MD.0000000000036599. PMID: 38065920; PMCID: PMC10713174.
84. Anyiam AF, Arinze-Anyiam OC, Irondi EA, Obeagu EI. Distribution of ABO and rhesus blood grouping with HIV infection among blood donors in Ekiti State Nigeria. Medicine (Baltimore). 2023;102(47): e36342. doi: 10.1097/MD.0000000000036342. PMID: 38013335; PMCID: PMC10681551.
85. Echefu SN, Udosen JE, Akwiwu EC, Akpotuzor JO, Obeagu EI. Effect of Dolutegravir regimen against other regimens on some hematological parameters, CD4 count and viral load of people living with HIV infection in South Eastern Nigeria. Medicine (Baltimore). 2023;102(47): e35910. doi: 10.1097/MD.0000000000035910. PMID: 38013350; PMCID: PMC10681510.
86. Opeyemi AA, Obeagu EI. Regulations of malaria in children with human immunodeficiency virus infection: A review. Medicine (Baltimore). 2023;102(46): e36166. doi: 10.1097/MD.0000000000036166. PMID: 37986340; PMCID: PMC10659731.
87. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Ogunnaya FU, Ngwoke AO, Emeka-Obi OR,
88. Obeagu EI, Ubosi NI, Uzoma G. Storms and Struggles: Managing HIV Amid Natural Disasters. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(11):14-25.

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

89. Obeagu EI, Obeagu GU. Human Immunodeficiency Virus and tuberculosis infection: A review of prevalence of associated factors. Int. J. Adv. Multidiscip. Res. 2023;10(10):56-62.
90. Obeagu EI, Obeagu GU. Early Infant Diagnosis: A Crucial Step in Halting HIV Transmission. Elite Journal of Health Science, 2023; 1(1):1-11
91. Obeagu EI, Obeagu GU. Early Infant Diagnosis: Shielding Infants from HIV Transmission. Elite Journal of Health Science, 2023; 1(1):12-22
92. Obeagu EI, Obeagu GU. Protecting Generations: Early Infant Diagnosis's Role in Preventing HIV Spread. Elite Journal of Public Health, 2023; 1 (1): 1-11
93. Obeagu EI, Obeagu GU. Securing Health: The Role of Early Infant Diagnosis in Preventing HIV in Newborns. Elite Journal of Public Health, 2023; 1 (1): 12-22
94. Obeagu EI, Obeagu GU. Empowering Health Systems: Early Infant Diagnosis's Impact on Preventing HIV in Newborns. Elite Journal of Public Health, 2023; 1 (1): 23-33
95. Obeagu EI, Obeagu GU. From Classroom to Home: Strengthening the Continuum of Sickle Cell Disease Knowledge. Elite Journal of Health Science, 2023; 1(1):23-29
96. Obeagu EI, Obeagu GU. Incorporating Sickle Cell Disease Curriculum in Schools: An Effective Approach. Elite Journal of Health Science, 2023; 1(1):30-36
97. Obeagu EI, Obeagu GU. Community Leaders as Educators: Mobilizing for Sickle Cell Disease Reduction. Elite Journal of Health Science, 2023; 1(1):37-43
98. Obeagu EI, Obeagu GU. Peer-to-Peer Learning Networks: Sickle Cell Disease Education Among Adolescents. Elite Journal of Public Health, 2023; 1 (1): 34-41
99. Obeagu EI, Obeagu GU. From Awareness to Action: Encouraging Adolescent Engagement in Sickle Cell Disease Prevention. Elite Journal of Public Health, 2023; 1 (1): 42-50
100. Obeagu EI, Obeagu GU. The Vital Role of Antioxidants in Enhancing Fertility and Pregnancy Success: A Review. Elite Journal of Nursing and Health Science, 2023; 1(1):1-12
101. Obeagu EI, Obeagu GU. Harnessing the Power of Antioxidant-Rich Diet for Preconception Health: A Review. Elite Journal of Health Science, 2023; 1(1):1-13
102. Obeagu EI. Unraveling Diagnostic Challenges of Aplastic Anemia in the Context of HIV: A Review. Elite Journal of Nursing and Health Science, 2023; 1(1):13-23
103. Obeagu EI. **I**mmunological Insights into Aplastic Anemia within the Context of HIV: Unraveling the Complex Interplay. Elite Journal of Health Science, 2023; 1(1):14-24
104. Obeagu EI. Treatment Strategies for Aplastic Anemia in HIV: Current Approaches and Future Directions. Elite Journal of Laboratory Medicine, 2023; 1(1): 1-12
105. Hackl L, Itzkowitz L, Koso-Thomas M, Moorthy D, Owino V, Pachón H, Stoffel N, Zimmerman M, Raiten D, Loechl C, Datta-Mitra A. Approaches to Address the Anemia Challenge. The Journal of Nutrition. 2023;153(Suppl 1).
106. Obeagu EI. Iron Overload in HIV: Implications for Disease Management. Elite Journal of HIV, 2023; 1(1): 15-28
107. Obeagu EI. Hemochromatosis and HIV: Two Conditions, One Challenge. Elite Journal of Laboratory Medicine, 2023; 1(1): 13-27

Citation: Obeagu EI. Ceruloplasmin and HIV-Associated Coagulopathies: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 28-41

108. Obeagu EI. Iron Overload in HIV: Implications for Antiretroviral Therapy. Elite Journal of Health Science, 2023; 1(1):25-37
109. Obeagu EI. Hemochromatosis and HIV: Implications for Immune Reconstitution. Elite Journal of Health Science, 2023; 1(1):17-30
110. Obeagu EI. Ceruloplasmin and Oxidative Stress in HIV: A Review. Elite Journal of HIV, 2023; 1(1): 29-42