

Medical Microbiology in the Genomics Era Case Study Assessment 2023-24

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1.0 Case Study 1: HIV Infection and Secondary Opportunistic Infection

1.1 Introduction

We introduce the report dealing with a case study at age 31 where the return from Mexico is connected to have a complex clinical state. A case of an HIV kid who is two years old suffering from severe abdominal pain, diarrhea, cough and excessive weight loss. In the case of a reasonably high level of HIV viral load and CD4 T lymphocyte count, this syndrome requires an immediate search for opportunistic infections (Hooshyar and Rostamkhani, 2022). Timely and accurate diagnosis is critical in the treatment of HIV+ people because their secondary infections that would lead to could prove deadly. To understand the relationship between HIV pathology and secondary infections, it is necessary to study the clinical manifestations of a patient and timely provide him or her with adequate treatment.

1.2 Symptoms and Initial Differential Diagnosis

The patient presents with a constellation of symptoms: In the first place, fever, abdominal pain, bloody diarrhea, cough and post-holiday weight loss in Mexico. Such presentations could be an array of intestinal and respiratory disorders aggravated by HIV-induced immunodeficiency (Haukoos et al., 2018). The fever and diarrhea indicate the presence of an enteric pathogen, whereas the cough and the weight loss can lead to a respiratory infection or a condition associated with HIV, such as tuberculosis. Considering the travel history, other tropical infections like typhoid or amoebiasis begin to be included in the differential diagnosis. An elevated viral load and a low CD4 count favour the development of opportunistic infections such as PCP and CMV infection (Al-Khayat et al., 2021). From the clinical point of view, it is very important to concentrate first on the most dangerous diagnoses for a patient's life today, therefore, that require urgent and timely procedures.

1.3 Laboratory Findings and Presumptive Diagnosis

The laboratory findings suggested very high HIV viral load, above 10,000 copies/ml and low dangerous CD4 T lymphocyte count, less than 200 cells/mm³ which is a sign of severe immunosuppression and AIDS-defining parameters. This immunologic pattern makes the patient more likely to develop various opportunistic infections. The elevated alkaline phosphatase level of 150 IU/L and the elevated white blood cell count suggest an inflammatory or infectious process

(Haghighi et al., 2018). The abdominal ultrasound showed an abdomen abscess in the right lobe of the liver, often associated with parasite infections or septic emboli. Based on the microscopic analysis of a stool specimen, trophozoites and cysts were identified – typical signs of protozoal infection. It is anticipated that a parasitic infection, including amoebiasis, which may produce liver abscesses and gastrointestinal presentation, has occurred because of liver abscess, stool findings, and patient characteristics. The liver abscess and protozoa in the stool are indicative of extra intestinal amoebiasis that which means that the patient needs to be treated intensively and directly because the condition of the HIV patient changes rapidly.

1.4 Further Diagnostic Tests

The presence of protozoa in the sample, liver abscess also requires additional diagnostic procedures to determine the causative agent and the choice of specific treatment. In such a case PCR amplification of protozoan DNA from stools or abscess aspirate would turn into a gold standard for a conclusive diagnosis. The high sensitivity of PCR enables detection of low parasite loads that may easily be missed in routine microscopy, and the specificity helps in distinguishing closely related protozoan species (Gupta et al., 2018). Introducing genomic-oriented diagnostic methods like real-time PCR could allow obtaining highly specific and fast results. These techniques enable measurement of the parasite load—an important parameter for disease trajectory and treatment response assessment. DNA sequencing, or restriction fragment length polymorphism analysis, may be used as definitive speciation. Supportive serological tests against the potential pathogen may be informative when PCR is unclear.

1.5 Final Diagnosis and Discussion

The last diagnosis, which was clinical, laboratory, and advanced genomic based, identifies as extra intestinal amoebiasis in the form of liver abscess and gastrointestinal symptoms. The finding of trophozoites and cysts on the stool, along with the ultrasound results and the patient's immunosuppression, confirms this diagnosis (Guillén, 2023). Emerging clues from conventional diagnostic methods, like microscopy, revealed insufficient specificities to discriminate amoeba species. Diagnosis using the genomic-based diagnostics, especially PCR tests, provided a conclusive diagnosis through identification of DNA sequences specific to the causing protozoan. Genomic diagnostics enable the quantification of parasitic load, a capability not

possible with traditional microscopy and improving treatment monitoring (Flaih et al., 2021). The use of such state-of-the-art diagnostics is particularly important in individuals, where early and accurate diagnosis can significantly change the prognosis and outcome of the situation itself.

1.6 Treatment and Prognosis

The HIV treatment plan should include the continuation of ART to keep the viral load suppressed, which in turn may help improve the CD4 counts. With the diagnosed extra intestinal amoebiasis, a metronidazole course is recommended to act against the active trophozoites, followed by a luminal agent such as paromomycin that targets the cysts staying in the intestine and aids to preventing the relapse of the infection (Caruso et al., 2021). The prognosis for this patient will greatly rely on early HIV treatment of amoebiasis and HIV management. Due to the high viral load and low CD4 count, the advanced HIV implies that the patient has a slow reaction to the infection and high possibilities of developing other opportunistic infections. Yet, provided successful ART and amoebicidal treatment, there is hope for great progress Liver function, CD4 counts, and HIV viral load monitoring will be crucial to tell about treatment efficacy, as well as to revise the approach whenever the need arises. Treatment initiated early and aggressively makes a positive prognosis more likely.

1.7 Transmission and Prevention

It is transmitted through the fecal-oral route, and the extra intestinal amoebiasis, which most likely was acquired during the patient's visit to Mexico, has been detected (Black et al., 2017). But this transmission may occur via ingestion of contaminated food or water, or person-to-person contact. It is possible that the patient ingested contaminated food or water which contained the cyst form of the amoeba, considering his travel history. The preventive actions shall include access to clean water, sanitation and quality food standards especially in the endemic areas of amoebiasis. Other public health measures that they should learn is personal hygiene as proper handwashing is an essential aspect of avoiding such infections (Bandera et al., 2019). HIV prevention measures include teaching people safe sex practices, needle exchange programs and universal testing for HIV counseling.

1.8 Conclusion

The relationship between HIV and adaptable infections with extra intestinal amoebiasis is highlighted in the case study below. The concept also concentrates on the importance of such innovative diagnostic protocols that employ traditional modalities as well as modern genomic technologies to achieve better diagnostics for targeted therapy. This case also highlights the important preventive mechanisms and public health interventions needed to curb these infections.

2.0 Case Study 2: Severe Headache and Blistering Rash with Potential HSV-2 Infection

2.1 Introduction

This shows a 25-year-old school teacher presenting a severe head pain, photophobia (from lights), neck stiffness, nausea and vomiting, weakness, and genital ulcers. The identified indices point to a possible CNS infection alongside dermatological symptoms (Yacouba et al., 2017). It is important to make a proper diagnosis because coincidence of neurological and cutaneous signs may be caused by several diseases that need different treatments. The importance of accuracy in diagnosis is reflected in this case, as the patient receives an adequate and early treatment that suppresses complications.

2.2 Symptoms and Initial Differential Diagnosis

The case has a moderate headache, photophobia, and stiff neck with nausea, vomiting, and malaise. The dermatological aspect of the clinical picture is greatly enhanced by the occurrence of genital blisters (World Health Organization, 2017). Classic symptoms for meningitis include the symptoms of headache, photophobia, and neck stiffness. This is also substantiated by the positive Brudzinski's and Kernig's signs, as they testify to the meningeal irritation. These signs are induced by certain maneuvers performed during the physical examination; they indicate meningeal inflammation. With the occurrence of genital pustules, a viral origin like herpes simplex virus (HSV) has to be taken into account, particularly HSV-2, which is found in genital ulcers. Other differentials could include bacterial meningitis, although the lack of temperature may be unconventional (Thomford et al., 2018). Even although viral encephalitis is usually caused by enteroviruses or arboviruses it can also have similar symptoms but usually is accompanied by the fever and changes in mental status.

2.3 Laboratory Findings and Presumptive Diagnosis

The HIV test of the patient was negative eliminating the possibility of HIV-related neurological complications. The lumbar puncture results were essential in informing the provisional diagnosis (Stensvold et al., 2018). The results of high count, high protein concentration but normal glucose levels in the cerebrospinal fluid (CSF) are indicative of viral meningitis because low glucose levels in the CSFs are characteristic of a bacterial meningitis. PCR analysis of the CSF and lesions was done, which demonstrated positivity for a pathogen that was consistent with HSV. Although PCR

is very sensitive and specific in analyzing HSV DNA, it does not usually distinguish between HSV-1 and HSV-2. In the light of genital blisters and PCR results, a presumptive diagnosis of HSV-2 causing viral meningitis can be established (Shirley et al., 2018). This is further supported by the lack of other common viral pathogens in the PCR results and the clinical presentation of the patient. It should also be noted that although HSV-2 is known to be one of the causes of genital infections, it can produce neurological symptoms such as meningitis mainly in non-immunosuppressed persons.

2.4 Further Diagnostic Tests for HSV Differentiation

Traditional PCR for HSV does detect HSV DNA, it is unable to differentiate HSV-1 from HSV-2. This limitation is a result of PCR, which selects DNA fragments for HSV-1 and HSV-2 differentiation in this patient but not antigen detection techniques such as type specific glycoprotein G based assays that are applied. Glycoprotein G may be an excellent discriminator for specific strains of HSV-1 and 2 (Rutstein et al., 2017). Through this approach, antibodies attack glycoprotein G of either HSV-1 or HSV-2 that makes it a simple difference between the two strains. This method is related to the identification of two different types of HSV that allow for proper diagnosis and treatment. Defining HSV-2 induced meningitis and paving the way for disease specific treatment, monitoring of a causal agent in this patient by detection of its kind is important.

2.5 Final Diagnosis and Discussion

The final diagnosis depends on clinical findings and antigen detection tests identifying that an organism that causes HSV-2 associated neurological and cutaneous symptoms is a viral pathogen. PCR demonstrated the presence of HSV DNA in CSF and lesions; later, HSV-2 specific glycoprotein G was found by antibody detection tests. In comparison with other diagnostic techniques, PCR is a good antidote for confirmation of an HSV infection; however, it rarely affords specificity in differentiating between HSV-1 and HSV-2. Antigen detection. This case played a major role in determining the application of antigen detection, HSV-2 determination, recommendations for treatment and results associated with them (Li et al. 2021). This case underscores the importance of using a combination of diagnostic methods: First, detection of HSV

through PCR and antigen detection tests that allow identifying particular strains necessary for correct diagnosis and treatment.

2.6 Treatment and Prognosis

In the case of confirmed HSV-2 infection especially with the neurological involvement the best treatment option would be anti-viral treatment blood acyclovir administration. Due to its efficacy in suppressing viral replication and relieving symptoms, this antiviral has been permitted to be used as the primary treatment for HSV-2 meningitis (Li et al., 2021). The duration of treatment may vary but typically is prescribed for 10 to 14 days for HSV-2 meningitis in men. There is symptomatic treatment for headache, photophobia, and several other discomforts. The early diagnosis and treatment of HSV-2 meningitis is usually favorable. Timely initiation of antiviral treatment to significantly reduce the risk of morbidity and speed recovery. However, the reactivation of HSV-2 should also be monitored because this virus is likely to return. Based on the patient's reaction and relapse tendency, it may be reasonable to perform regular control and even prolonged therapeutic suppression.

2.7 Transmission and Prevention

HSV-2 is commonly sexually transmitted through oral, anal and genital direct contacts. When there are no sores, the virus can be transmitted even in the case of asymptomatic viral shedding. To prevent transmission, safe sex practices such as reliable and proper use of condoms are required. The HSV-2 is also important in educating people on the dangers and signs of HSV-2 to reduce transmission (Hsue and Waters, 2019). In known HSV-2 infections, the suppressive antiviral therapy can reduce the rate of outbreak and the transmission of the virus to the sexual partners. Additional preventive measures are avoiding sexual activities during active lesions and informing partners of the infection. It is also useful to promote prevention and control activities through periodic screening and open discussions about sexual health.

2.8 Conclusion

This case shows the issues of diagnosis and treatment of HSV-2 especially in neurological manifestation. It emphasizes the need for the use of a battery of various diagnostic measures including PCR and antigen detection to differentiate HSV-1 from HSV-2, and, to choose the

correct treatment. The effectiveness of antiviral therapy in containing HSV-2 meningitis is proof of the importance of early diagnosis and treatment.

References

- Al-Khayat, F.A.A.M., Al-Zubaidi, H.J. and Aldhafer, Z.A., 2021. Entamoeba histolytica, identification in asymptomatic infection. *Pakistan Journal of Medical and Health Sciences*, 15(2), pp.473-477.
- Bandera, A., Gori, A., Clerici, M. and Sironi, M., 2019. Phylogenies in ART: HIV reservoirs, HIV latency and drug resistance. *Current opinion in pharmacology*, 48, pp.24-32.
- Black, R.E., Taylor, C.E., Arole, S., Bang, A., Bhutta, Z.A., Chowdhury, A.M.R., Kirkwood, B.R., Kureshy, N., Lanata, C.F., Phillips, J.F. and Taylor, M., 2017. Comprehensive review of the evidence regarding the effectiveness of community-based primary health care in improving maternal, neonatal and child health: 8. summary and recommendations of the Expert Panel. *Journal of global health*, 7(1).
- Caruso, G., Giammanco, A., Virruso, R. and Fasciana, T., 2021. Current and future trends in the laboratory diagnosis of sexually transmitted infections. *International Journal of Environmental Research and Public Health*, 18(3), p.1038.
- Flaih, M.H., Khazaal, R.M., Kadhim, M.K., Hussein, K.R. and Alhamadani, F.A.B., 2021. The epidemiology of amoebiasis in Thi-Qar Province, Iraq (2015-2020): differentiation of Entamoeba histolytica and Entamoeba dispar using nested and real-time polymerase chain reaction. *Epidemiology and health*, 43.
- Guillén, N., 2023. Pathogenicity and virulence of Entamoeba histolytica, the agent of amoebiasis. *Virulence*, 14(1), p.2158656.
- Gupta, R.K., Gregson, J., Parkin, N., Haile-Selassie, H., Tanuri, A., Forero, L.A., Kaleebu, P., Watera, C., Aghokeng, A., Mutenda, N. and Dzangare, J., 2018. HIV-1 drug resistance before initiation or re-initiation of first-line antiretroviral therapy in low-income and middle-income countries: a systematic review and meta-regression analysis. *The Lancet infectious diseases*, 18(3), pp.346-355.
- Haghighi, A., Riahi, S.M., Taghipour, A., Spotin, A., Javanian, M., Mohammadi, M., Dooki, M.E. and Rostami, A., 2018. Amoebiasis in Iran: a systematic review and meta-analysis. *Epidemiology & Infection*, 146(15), pp.1880-1890.

- Haukoos, J.S., Lyons, M.S. and Rothman, R.E., 2018. The evolving landscape of HIV screening in the emergency department. *Annals of emergency medicine*, 72(1), pp.54-56.
- Hooshyar, H. and Rostamkhani, P., 2022. Accurate laboratory diagnosis of human intestinal and extra-intestinal amoebiasis. *Gastroenterology and Hepatology From Bed to Bench*, 15(4), p.343.
- Hsue, P.Y. and Waters, D.D., 2019. HIV infection and coronary heart disease: mechanisms and management. *Nature Reviews Cardiology*, 16(12), pp.745-759.
- Li, J., Cui, Z., Li, X. and Zhang, L., 2021. Review of zoonotic amebiasis: Epidemiology, clinical signs, diagnosis, treatment, prevention and control. *Research in veterinary science*, 136, pp.174-181.
- Liu, P., Tang, Z., Lan, G., Zhu, Q., Chen, H., You, Y., Yang, X., Liang, S., Chen, Y., Xing, H. and Liao, L., 2018. Early antiretroviral therapy on reducing HIV transmission in China: strengths, weaknesses and next focus of the program. *Scientific reports*, 8(1), p.3431.
- McCluskey, S.M., Siedner, M.J. and Marconi, V.C., 2019. Management of virologic failure and HIV drug resistance. *Infectious Disease Clinics*, 33(3), pp.707-742.
- Rutstein, S.E., Ananworanich, J., Fidler, S., Johnson, C., Sanders, E.J., Sued, O., Saez-Cirion, A., Pilcher, C.D., Fraser, C., Cohen, M.S. and Vitoria, M., 2017. Clinical and public health implications of acute and early HIV detection and treatment: a scoping review. *Journal of the International AIDS Society*, 20(1), p.21579.
- Shirley, D.A.T., Farr, L., Watanabe, K. and Moonah, S., 2018, July. A review of the global burden, new diagnostics, and current therapeutics for amebiasis. In *Open forum infectious diseases* (Vol. 5, No. 7, p. ofy161). US: Oxford University Press.
- Stensvold, C.R., Winiecka-Krusnell, J., Lier, T. and Lebbad, M., 2018. Evaluation of a PCR method for detection of *Entamoeba polecki*, with an overview of its molecular epidemiology. *Journal of clinical microbiology*, 56(5), pp.10-1128.
- Thomford, N.E., Senthebane, D.A., Rowe, A., Munro, D., Seele, P., Maroyi, A. and Dzobo, K., 2018. Natural products for drug discovery in the 21st century: innovations for novel drug discovery. *International journal of molecular sciences*, 19(6), p.1578.

World Health Organization, 2017. *Integrating neglected tropical diseases into global health and development: fourth WHO report on neglected tropical diseases*. World Health Organization.

Yacouba, A., Sawadogo, M.P., Diallo, I., Sangare, I., Bamba, S., Ouattara, B. and Guiguemde, T.R., 2017. Opportunistic and other intestinal parasites infections among HIV-positive patients in the era of combination antiretroviral therapy and preventive treatment in Ouagadougou, Burkina Faso. *Journal of HIV for Clinical and Scientific Research*, 4(1), pp.008-014.