International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 11, Issue 2, pp: (91-94), Month: October 2023 - March 2024, Available at: www.researchpublish.com

Dengue Fever and Laboratory Testing

Abdulrahman Abdulkhalig Alshamrani[1], Fahad Mohammed Alwalan[2], Noor asaad Aljasham[3], Abdulrahman saleh bin suliman[4], Nourah Ghanim Alshammari[5], Sultan Hamad B Alkhaibari[6], Bassam Mushabbab A Alshahrani[7], Abdulrhman Mohammed Hadi twhari[8], Ahmed Hattan Hattan[9], Areej Nasser Saud AlRami[10], Mohammed Khalid Bahakim[11]

[1] Corresponding Author, Lab specialist, PCLMA, KFMC, Riyadh, SA

[2] Lab specialist, PCLMA, KFMC, Riyadh, SA

[3] Lab specialist, PCLMA, KFMC, Riyadh, SA

[4] Lab specialist, PCLMA, KFMC, Riyadh, SA

[5] Lab specialist, PCLMA, KFMC, Riyadh, SA

[6] Specialist-Laboratory, PCLMA, KFMC, Riyadh, SA

[7] Specialist-Laboratory, PCLMA, KFMC, Riyadh, SA

[8] LAB TECH, PCLMA, KFMC, Riyadh, SA

[9] LAB TECH, PCLMA, KFMC, Riyadh, SA

[10] LAB TECH, PCLMA, KFMC, Riyadh, SA

[11] LAB TECH, PCLMA, KFMC, Riyadh, SA

DOI: https://doi.org/10.5281/zenodo.10435221

Published Date: 27-December-2023

Abstract: **Dengue fever is a mosquito-borne infection that affects millions of people worldwide each year. The disease is endemic in many tropical and subtropical regions, placing individuals at risk of severe illness, including dengue hemorrhagic fever and dengue shock syndrome. Effective laboratory testing plays a vital role in diagnosing and managing dengue fever, especially at the doctoral level, where advanced techniques are employed to ensure and timely diagnosis. In conclusion, laboratory testing plays a pivotal role in the diagnosis and management of dengue fever. The availability of reliable and efficient laboratory tests, such as RT-PCR and serology, allows healthcare providers to accurately identify the dengue virus, differentiate it from other similar diseases, and guide appropriate patient care. Alongside clinical evaluation and patient history, laboratory testing provides valuable information for epidemiological surveillance and public health interventions to control the spread of this significant global health threat.**

Keywords: **Dengue fever, RT-PCR, laboratory testing.**

I. INTRODUCTION

Dengue fever is a viral infection caused by the dengue virus, which is transmitted to humans through the bite of infected female mosquitoes, primarily of the Aedes aegypti species. This disease is one of the most prevalent mosquito-borne illnesses worldwide, particularly in tropical and subtropical regions. Dengue fever is characterized by symptoms such as high fever, severe headache, joint and muscle pain, rash and in severe cases, it can lead to hemorrhage or organ failure, which can be fatal if not treated promptly.

Photo 1: The mosquito *Aedes aegypti* feeding on a human host

Dengue fever virus (DENV) is an RNA virus of the family *Flaviviridae*; genus *Flavivirus*. Other members of the same genus include yellow fever virus, West Nile virus, Zika virus, St. Louis encephalitis virus, Japanese encephalitis virus, tick-borne encephalitis virus, Kyasanur forest disease virus, and Omsk hemorrhagic fever virus. Most are transmitted by arthropods (mosquitos or ticks), and are therefore also referred to as arboviruses (*ar*thropod-*bo*rne viruses).

The dengue virus genome (genetic material) contains about 11,000 nucleotide bases, which code for the three different types of protein molecules (C, prM and E) that form the virus particle and seven other non-structural protein molecules (NS1, NS2a, NS2b, NS3, NS4a, NS4b, NS5) that are found in infected host cells only and are required for replication of the virus. There are five strains of the virus, called serotypes, of which the first four are referred to as DENV-1, DENV-2, DENV-3 and DENV-4. The fifth type was announced in 2013. The distinctions between the serotypes are based on their antigenicity.

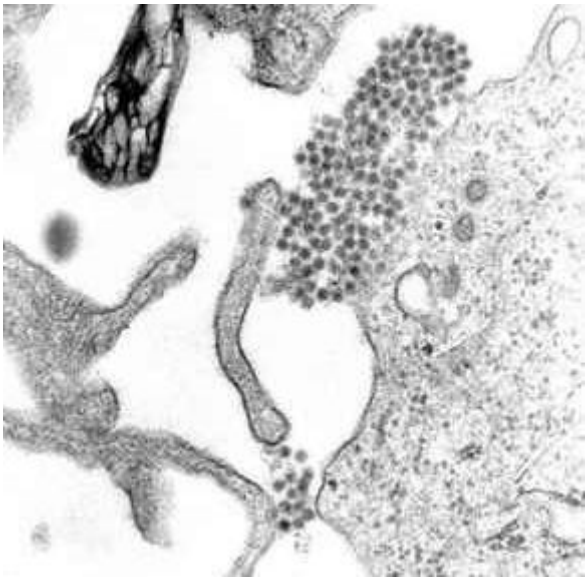

Photo 2: A TEM micrograph showing dengue virus virions (the cluster of dark dots near the center)

Due to the global impact of dengue fever, it is crucial to accurately diagnose and manage this disease to prevent severe complications and reduce its spread. Laboratory testing plays a vital role in the diagnosis of dengue fever. It allows healthcare providers to confirm the presence of the dengue virus in a patient's blood and differentiate it from other similar illnesses, such as malaria or chikungunya.

The gold standard laboratory test for dengue fever is the reverse transcription-polymerase chain (RT-PCR). This molecular test detects the genetic material of the dengue virus in a patient's blood sample. It provides high sensitivity and specificity, allowing early diagnosis and differentiation between the four different serotypes of the dengue virus. Identifying the specific serotype is crucial for epidemiological surveillance and outbreak control measures.(1,2)

Another commonly used laboratory test for dengue fever is the detection of dengue virus-specific antibodies in a patient's blood. This test is known as serology or antibody testing. It detects the presence of immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies produced by the immune system in response to the infection. IgM antibodies are the first to appear during the acute phase of the illness, while IgG antibodies persist for a longer duration. Serology tests provide valuable information about the patient's immune response and can also differentiate between primary and secondary dengue infections.

In addition to RT-PCR and serology tests, laboratory testing for dengue fever may include other methods such as antigen detection and viral isolation. Antigen detection tests identify viral proteins present in a patient's blood sample. These tests are often used during the early phase of the illness when viral replication is at its peak. Viral isolation involves growing the dengue virus in a laboratory setting, which is time-consuming and requires specialized facilities. This method is less commonly used due to its complexity and the availability of more efficient molecular tests.(3)

The accurate and timely diagnosis of dengue fever is crucial for appropriate patient management and public health interventions. Laboratory testing enables healthcare providers to confirm the dengue infection, monitor disease progression, and make informed treatment decisions. It also helps in epidemiological surveillance, outbreak investigation and implementation of mosquito control measures to prevent the spread of the disease.

II. SIGNIFICANCE OF LABORATORY TESTING IN DIAGNOSING DENGUE FEVER:

Timely and accurate diagnosis of dengue fever is crucial for patient management, outbreak control, and surveillance purposes. Laboratory testing is the cornerstone of dengue diagnosis as it enables the differentiation of dengue from other febrile illnesses, such as malaria, chikungunya, and Zika virus infection. Over the years, several diagnostic methods have been developed, allowing healthcare professionals to identify the virus and determine the stage of infection.(4)

III. METHODS USED IN LABORATORY TESTING AT THE DOCTORAL LEVEL:

1 .Serology: Serological tests, such as enzyme-linked immunosorbent assay (ELISA) and immunochromatographic tests (ICT), are commonly employed for dengue diagnosis. These tests detect the presence of viral antigens or antibodies in patient samples, aiding in the identification of dengue infection and distinguishing between primary and secondary infections.

These laboratory tests are only of diagnostic value during the acute phase of the illness with the exception of serology. Tests for dengue virus-specific antibodies, types IgG and IgM, can be useful in confirming a diagnosis in the later stages of the infection. Both IgG and IgM are produced after 5–7 days. The highest levels (titres) of IgM are detected following a primary infection, but IgM is also produced in reinfection. IgM becomes undetectable 30–90 days after a primary infection, but earlier following re-infections. IgG, by contrast, remains detectable for over 60 years and, in the absence of symptoms, is a useful indicator of past infection. After a primary infection, IgG reaches peak levels in the blood after 14–21 days. In subsequent re-infections, levels peak earlier and the titres are usually higher. Both IgG and IgM provide protective immunity to the infecting serotype of the virus. In testing for IgG and IgM antibodies there may be cross-reactivity with other flaviviruses which may result in a false positive after recent infections or vaccinations with yellow fever virus or Japanese encephalitis. The detection of IgG alone is not considered diagnostic unless blood samples are collected 14 days apart and a greater than fourfold increase in levels of specific IgG is detected. In a person with symptoms, the detection of IgM is considered diagnostic.

2 .Molecular Testing: Polymerase chain reaction and real-time PCR techniques allow the detection and quantification of viral genetic material in patient samples. These methods can identify all four serotypes of dengue virus, providing valuable information for epidemiological studies and outbreak investigations.

3 .Viral Isolation: Viable dengue virus can be isolated from patient samples using cell culture techniques, allowing for further characterization of the virus. Although resource-intensive and time-consuming, viral isolation plays a crucial role in research and vaccine development.(5,6)

IV. CHALLENGES FACED IN DENGUE DIAGNOSTICS:

Despite advancements in laboratory techniques, several challenges persist in dengue diagnostics. One major challenge is the need for specialized equipment and trained personnel to perform complex assays accurately. The laboratory infrastructure required for such testing may be lacking in resource-limited settings, where dengue burden is often highest. Additionally, the timing and availability of laboratory results can significantly impact patient management and outbreak response. Rapid diagnostic tests that provide quick and accurate results are thus essential.(6)

V. FUTURE PERSPECTIVES IN DENGUE DIAGNOSTICS:

Ongoing research aims to address the existing challenges in dengue diagnostics and improve patient care. Some areas of focus include:

1 .Point-of-care Testing: Development of rapid and user-friendly diagnostic tests that can be performed at the point of care without the need for specialized equipment or technical expertise.(7)

2 .Biomarkers: Identification of reliable biomarkers that can predict severe disease outcomes and determine patient response to treatment. This could aid in risk stratification and personalized management of dengue fever.(8)

3 .Multiplex Assays: Development of multiplex assays capable of simultaneously detecting multiple pathogens, including dengue virus and other co-circulating viruses, to aid in accurate differential diagnosis.(9)

VI. CONCLUSION

Laboratory testing at the doctoral level plays a vital role in the diagnosis and management of dengue fever. Advanced techniques, such as serology, molecular testing, and viral isolation, provide accurate and timely results, allowing healthcare professionals to differentiate dengue fever from other febrile illnesses and guide appropriate patient care. However, challenges in laboratory infrastructure, accessibility, and turnaround time still exist. Future research and innovation aim to address these challenges and improve diagnostic capabilities, leading to better outcomes for dengue-affected individuals worldwide.(10)

REFERENCES

[1] Bhatt S, Gething PW, Brady OJ, et al. The global distribution and burden of dengue. Nature. 2013 Apr 25;496(7446):504-7.

[2] WHO. Dengue: Guidelines for Diagnosis, Treatment, Prevention and Control. Geneva: World Health Organization; 2009.

[3] Shu PY, Chang SF, Kuo YC, et al. Development of Group- and Serotype-Specific One-Step SYBR Green I-based Real-Time Reverse Transcription-PCR Assay for Dengue Virus. J Clin Microbiol. 2003 Mar;41(3):2408-16.

[4] Parkash O, Shueb RH. Diagnosis of Dengue Infection Using Conventional and Biosensor Based Techniques. Viruses. 2015 Jul 9;7(7):5410-27.

[5] Libraty DH, Mäkelä S, Vlk J, et al. Clinical and immunological risk factors for severe disease in secondary dengue virus infections. PLoS One. 2018 Feb 15;13(2):e0192212.

[6] Simmons CP, Farrar JJ, Nguyen vV, et al. Dengue. N Engl J Med. 2012 Sep 13;367(11):991-2.

[7] Blacksell SD. Commercial dengue rapid diagnostic tests for point-of-care application: Recent evaluations and future needs? J Biomed Biotechnol. 2012;2012:151967.

[8] Chaterji S, Allen JC Jr, Chow A, et al. Evaluation of the NS1 rapid test and the WHO dengue classification schemes for use as bedside diagnosis of acute dengue fever in adults. Am J Trop Med Hyg. 2011 May;84(5):224-8.

[9] Tissera HA, Jayamanne BD, R R, et al Population biological impact of transgenic Aedes aegypti in a high-intensity dengue transmission setting. Elife. 2020 Nov 2;9:e61404.

[10] Muller DA, Depelsenaire AC, Young PR. Clinical and laboratory diagnosis of dengue virus infection. J Infect Dis. 2017 Sep 16;215(suppl_2):S89-S95.