Recent Advances in the Understanding and Management of Marburg Virus Disease: A Review of Current Research, Emerging Therapeutic Strategies -A Case Report

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DOI: https://doi.org/10.51584/IJRIAS.2025.100800080

Received: 27 August 2025; Accepted: 01 September 2025; Published: 16 September 2025

ABSTRACT

Marburg Virus Disease (MVD), a rare yet highly fatal viral hemorrhagic fever caused by the Marburg virus (MARV), remains a significant public health concern due to its high mortality rate and potential for outbreaks. While MVD has been recognized for decades, recent research advancements have provided new insights into its pathogenesis, diagnosis, and therapeutic interventions. This article reviews the latest research on MARV, including viral mechanisms, diagnostic tools, epidemiology, and the progress made in developing vaccines and treatments. In addition, we present a case report of a patient diagnosed with MVD, emphasizing clinical presentation, diagnostic challenges, management, and nursing care. Despite the challenges posed by MARV, recent strides in medical research offer hope for more effective management and eventual control of this deadly disease.[13]

Keywords— Marburg Virus Disease, viral hemorrhagic fever, viral mechanisms, pathogenesis, therapeutic interventions

INTRODUCTION

Marburg Virus Disease (MVD) is a severe viral infection caused by the Marburg virus (MARV), a member of the Filoviridae family. MVD typically presents with fever, vomiting, abdominal pain, diarrhea, and hemorrhagic symptoms, leading to multi-organ failure and death in up to 88% of cases. The virus is primarily transmitted to humans through direct contact with the bodily fluids of infected animals, particularly fruit bats, or through human-to-human transmission.

Despite the emergence of MVD in Africa since 1967, the disease continues to present significant diagnostic and management challenges. There are no licensed antiviral therapies for MVD, though recent research has seen progress in vaccine development, monoclonal antibody therapies, and improved diagnostics. This article presents a comprehensive review of the current understanding of MVD, with a focus on emerging research and an illustrative case report of a patient diagnosed with the disease[11], [13]

A. Pathogenesis of Marburg Virus Disease

The Marburg virus is an enveloped, single-stranded RNA virus that infects multiple host cells, including endothelial cells, monocytes, and hepatocytes. Recent studies have highlighted the virus's ability to evade the host immune response, particularly by inhibiting the production of interferons and other antiviral cytokines, contributing to systemic inflammation and hemorrhagic manifestations.

MARV's viral glycoprotein (GP) plays a critical role in its ability to enter host cells by binding to host receptors and facilitating viral fusion. This mechanism has made GP a target for vaccine and antibody therapies. Recent

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

preclinical studies have shown that neutralizing antibodies against MARV GP can effectively limit the virus's ability to infect host cells, and monoclonal antibody-based therapies are currently being tested in clinical trials.[14][2]

Epidemiology and Transmission

MVD is primarily transmitted through direct contact with infected animal fluids, particularly from fruit bats, which are considered the natural reservoir. Human-to-human transmission occurs through exposure to infected bodily fluids, putting healthcare workers and family members at risk during outbreaks.

Recent studies have emphasized the importance of early detection, isolation protocols, and contact tracing in controlling MARV outbreaks. A study on the 2023 outbreak in Equatorial Guinea highlighted the success of these strategies, even in resource-limited settings, underscoring the importance of effective public health surveillance and rapid response.[11]

TABLE I Features of Marburg disease

slno	Features		
	Category	Details	Sources
6	Epidemiology: Cases, Prevalence & Incidence	**Rwanda (2024):** 62 cases, 15 deaths (CFR ≈ 24.2%), 43 recovered, >80% HCWs infected. **Tanzania (2025):** 10 cases (2 confirmed, 8 probable), 10 deaths, CFR = 100%. **Equatorial Guinea (2023):** 17 confirmed cases, 12 deaths + 20 probable deaths, CFR ≈ 70–71%. **Ghana (2022):** 3 cases, all fatal, CFR = 75%.	WHO; The Guardian; Reuters; Wikipedia
	Risk Factors	**Animal–human:** Prolonged exposure to Rousettus aegyptiacus fruit bats in caves/mines. **Human–human:** Contact with infected fluids, contaminated objects, unsafe burials. **Nosocomial:** Healthcare workers & caregivers without PPE at high risk. **Attack rates:** 23% in family cohabitation, up to 81% in unprotected caregivers.	WHO; EMRO; CDC; Epidemic Control Toolkit
9	Clinical Manifestations	Early signs: Sudden fever, headache, myalgia, nausea, vomiting, diarrhea, abdominal pain. Progression: Rash, severe hemorrhage (mucosal bleeding), "ghost-like" appearance, extreme lethargy. Complications: Multi-organ failure, coagulopathy, liver/renal dysfunction, cerebral edema, metabolic acidosis.	EMRO; The Guardian; Wiley Online Library
10	Morbidity & Mortality	FR varies 24%–100%, depending on outbreak & care capacity. Rwanda: ~24% Tanzania: 100% Equatorial Guinea: ~71% Ghana: 75% WHO historical average: ~50% (range 24–88%).	WHO; The Guardian; Reuters; Epidemic Control Toolkit; Wikipedia

11	Complications	**Hemorrhage:** 60% of patients. **Coagulopathies:** 33.3%. **Liver failure/hepatitis:** ~20%. **Other:** lymphadenopathy, cerebral edema, hepatic necrosis, renal failure, metabolic acidosis.	Wiley Online Library
24	Prevention	**Primary:** Avoid bat/primate exposure; safe body fluid handling; PPE use; HCW/community education. **Outbreak control:** Contact tracing, surveillance, safe burials, isolation, community engagement. **Experimental:** Rwanda (2024) used Sabin Institute candidate vaccine + remdesivir.	WHO; CDC; EMRO; Epidemic Control Toolkit; The Guardian

Marburg Virus Disease (MVD) is a rare but highly lethal viral hemorrhagic fever caused by the Marburg virus, a member of the *Filoviridae* family, which also includes the Ebola virus[8]. First identified in 1967 during simultaneous outbreaks in Marburg and Frankfurt (Germany) and Belgrade (Serbia), the disease has since caused sporadic outbreaks in Africa with case fatality rates ranging from 24% to 88%, depending on outbreak settings and healthcare capacity. It was traced to African green monkeys (*Chlorocebus aethiops*) imported from Uganda, resulting in 31 cases and 7 deaths.

Transmission occurs through zoonotic spillover from fruit bats (*Rousettus aegyptiacus*), followed by human-to-human spread via contact with blood, secretions, and contaminated materials. Clinically, MVD begins with sudden fever, chills, headache, and myalgia, progressing to severe diarrhea, vomiting, hemorrhage, multi-organ dysfunction, and shock.

Despite advances in research, there is currently no licensed antiviral treatment or vaccine. Management remains largely supportive, with emphasis on infection prevention, outbreak control, and experimental therapies under investigation.[12],[2]

The Marburg virus (MARV) has been recognized as a significant global health concern since its discovery in 1967. The first recorded outbreak occurred simultaneously in Marburg and Frankfurt (Germany), and Belgrade (then Yugoslavia), affecting laboratory workers exposed to African green monkeys imported from Uganda.[16] The outbreak resulted in 31 infections and 7 deaths, establishing the virus as a lethal human pathogen. Despite initial assumptions of limited spread, subsequent outbreaks—particularly in the Democratic Republic of Congo (1998–2000) and Angola (2004–2005)—revealed fatality rates as high as 83–90%.[15]

Pathophysiology and Immune Evasion

The incubation period of MARV ranges from 3 to 21 days, with an average of 5–10 days [17]. The virus initially infects monocytes, macrophages, and dendritic cells following entry via mucosal membranes or broken skin. Early replication occurs in the spleen and liver before systemic dissemination to endothelial cells, hepatocytes, and epithelial tissues.

Severe disease is characterized by a cytokine storm, coagulation abnormalities, hepatocellular necrosis, and multi-organ dysfunction (Mehedi et al., 2011). MARV evades host immunity primarily through inhibition of interferon type I (IFN-I) signaling, facilitated by VP35 and VP24 proteins[18] .

Case Report

Marburg Virus Disease (MVD) is a highly fatal zoonotic infection caused by the *Marburg virus* (MARV), a member of the *Filoviridae* family. Despite its similarity to Ebola Virus Disease (EVD), MVD remains comparatively under-researched, with limited therapeutic and preventive measures available. We present the

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

case of a 32-year-old male farmer from Central Africa, who developed MVD after exposure to fruit bats on his farm. This case highlights the clinical course, diagnostic challenges, and nursing management, while emphasizing gaps in current therapeutic options. [2]

Case Description:

Clinical Presentation

The patient, previously healthy, presented with an **acute febrile illness** after reported contact with dead fruit bats—a recognized zoonotic reservoir. On admission, vital signs were:

1. **Temperature:** 39.5 °C
2. **Pulse rate:** 110 bpm
3. **Blood pressure:** 90/60 mmHg
4. **Respiratory rate:** 26/min
5. **SpO_2:** 93% on room air

He complained of high-grade fever, severe headache, diffuse myalgia, nausea, recurrent vomiting, and abdominal pain.

By the fifth day of illness, the clinical picture deteriorated. The patient developed:

1. Profuse watery diarrhea resulting in dehydration
2. Petechial rash on the trunk and extremities
3. Hemorrhagic manifestations, including hematemesis, epistaxis, and bleeding from venipuncture sites

Laboratory Findings:

Initial investigations revealed:

1. **Hematology:** Leukopenia (WBC 2,100/µL), thrombocytopenia (45,000/µL)
2. **Liver function:** AST 480 U/L, ALT 350 U/L
3. **Renal function:** Creatinine 2.3 mg/dL, BUN 48 mg/dL
4. **Coagulation profile:** Prolonged PT/INR (1.9) with low fibrinogen levels
5. **Virology:** Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) confirmed *Marburg virus RNA*

These findings were consistent with viral hemorrhagic fever. Differential diagnoses such as Ebola Virus Disease, severe malaria, and typhoid were excluded by negative rapid tests and confirmatory molecular assays.

TABLE 2 Clinical and Laboratory Parameters During Hospitalization of a Patient with Marburg Virus Disease

Parameter	Day 1 (Admission)	Day 3	Day 5	Day 7	Day 10 (Outcome)
Temperature (°C)	39.5	39.2	38.8	39.6	40.0
Pulse (bpm)	110	118	124	130	142

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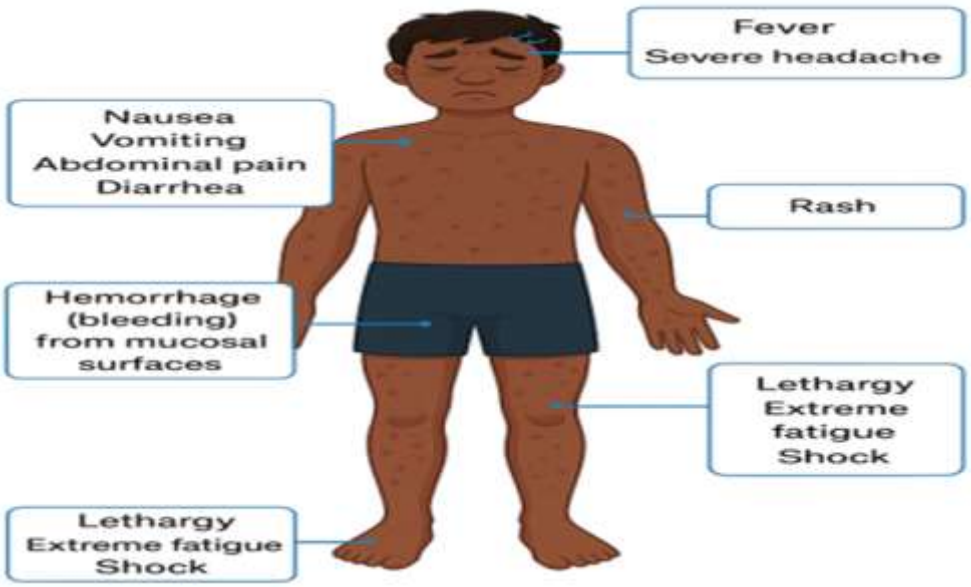
Blood Pressure (mmHg)	90/60	88/58	86/55	80/50	70/45
Respiratory Rate (/min)	26	28	30	32	34
SpO_2 (%)	93	92	90	88	85
Key Clinical Features	Fever, headache, abdominal pain	Persistent vomiting, weakness	Profuse diarrhea, petechiae	Hematemesis, epistaxis	Multi-organ failure, shock
WBC (cells/µL)	2,100	1,900	1,700	1,600	1,500
Platelets (/µL)	45,000	40,000	38,000	32,000	25,000
AST (U/L)	480	520	610	700	820
ALT (U/L)	350	390	450	520	600
Creatinine (mg/dL)	2.3	2.6	3.0	3.8	4.5
BUN (mg/dL)	48	55	60	72	88
PT/INR	1.9	2.1	2.3	2.5	2.8
Fibrinogen (mg/dL)	Low (120)	110	95	80	65
PCR (MARV RNA)	Positive	Positive	Positive	Positive	Positive

Upon presentation, the patient was placed in isolation, and supportive care was initiated, including fluid and electrolyte management, blood transfusions, and pain control. Despite these interventions, the patient's condition deteriorated rapidly, and he succumbed to multi-organ failure after 10 days of hospitalization. The nursing team faced significant challenges, particularly regarding the use of barrier and reverse barrier nursing and adherence to strict infection control protocols.[12],[13]

These findings were highly suggestive of viral hemorrhagic fever.[12] [5]

Fig 1 Clinical Features of Marburg virus disease



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Diagnostic Challenges:

1. Early recognition of MVD is complicated by its overlap with endemic febrile illnesses such as malaria and typhoid. In this case, diagnosis was delayed due to nonspecific prodromal symptoms. Although RT-PCR confirmed the infection, access to molecular testing was limited.
2. Recent advances in rapid antigen-detection assays (2024 studies) demonstrate sensitivity approaching that of PCR, with significant potential for use in outbreak-prone and resource-limited regions. Such tools could transform case detection, isolation, and surveillance strategies.
3. **Recent advances in diagnostic technology** have seen the development of a rapid antigen-detection RDT for MARV, which demonstrated comparable sensitivity to PCR testing in field settings. Such tests could significantly enhance outbreak response efforts, especially in resource-constrained areas.[3]
4. **Hematological investigations** revealed leukopenia, thrombocytopenia, and elevated liver enzymes (AST and ALT).
5. **RT-PCR (Reverse Transcriptase Polymerase Chain Reaction)** from a blood sample confirmed Marburg virus infection**.**
6. **Differential diagnoses** considered included Ebola Virus Disease, severe malaria, and typhoid fever; however, confirmatory testing established MVD. [9]

Management and Nursing Care:

The cornerstone of MVD treatment remains supportive care, as there are currently no approved antiviral therapies. The patient in the case report received intravenous fluids, electrolyte replacement, and blood transfusions to manage the complications of hemorrhage, shock, and multi-organ failure. [2] A single-shot ChAd3-MARV vaccine confers rapid and durable protection against Marburg virus in nonhuman primates.[1] Although experimental treatments such as monoclonal antibodies (e.g., REGN3470-3471-3479) show promise in preclinical studies, they were not available for this case.[7] [8]

Nursing care for patients with MVD requires strict adherence to infection control protocols to minimize the risk of healthcare-associated transmission. Nurses caring for patients with viral hemorrhagic fevers like MVD must wear full PPE and be trained in managing the challenges of such high-risk infections. Furthermore, nurses provide emotional support to both the patient and their families, who are under extreme stress due to the contagious nature and high mortality associated with MVD.[7] [10]

TABLE 3 Diagnostic workflow for suspected viral hemorrhagic fevers (MVD vs Ebola vs Lassa fever)

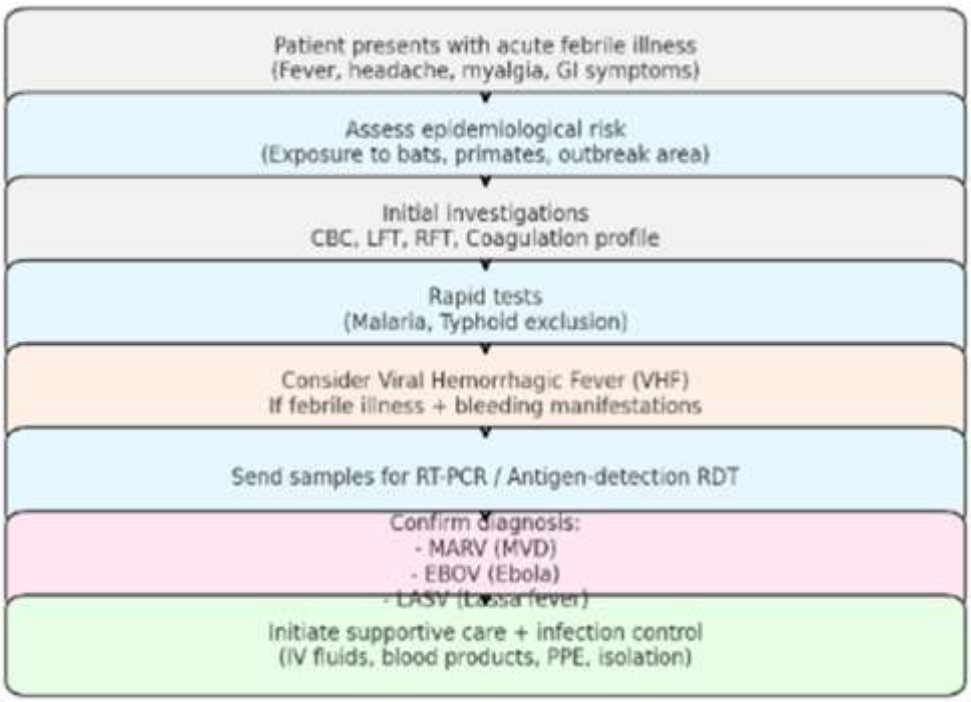

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TABLE 4 Timeline series of Marburg disease in various countries and locations

Year(s)	Country / Location	Cases	Deaths	Causative Organism	Signs & Symptoms	Treatment / Management
1967	Germany (Marburg, Frankfurt), Yugoslavia (Belgrade)	31	7	*Marburg virus* (Filoviridae family, closely related to Ebola virus)	Sudden fever, chills, severe headache, myalgia, nausea, vomiting, diarrhea, conjunctivitis, rash; later hemorrhage and multi-organ failure	Supportive care: rehydration, electrolyte balance, oxygen therapy, symptomatic treatment, infection prevention & control
1967	Germany (Marburg, Frankfurt), Yugoslavia (Belgrade)	31	7	*Marburg virus* (Filoviridae family, closely related to Ebola virus)	Sudden fever, chills, severe headache, myalgia, nausea, vomiting, diarrhea, conjunctivitis, rash; later hemorrhage and multi-organ failure	Supportive care: rehydration, electrolyte balance, oxygen therapy, symptomatic treatment, infection prevention & control
1975	South Africa (Johannesburg, imported from Zimbabwe)	3	1	Same as above	Same as above	Same as above
1980	Kenya (Kitum Cave,Mount Elgon)	2	1			
1987		1	1			
1998–2000	DRC (Durba/Watsa, Kivu)	154	128			
2004–2005	Angola (Uíge Province)	374	329		High fever, Vomiting, diarrhea, severe hemorrhage; very high fatality	Supportive only; isolation critical
2007	Uganda (Kabarole District)	4	1		Same as above	Same as above
2008	Netherlands & USA (Imported from Uganda - Python Cave)	2	1			

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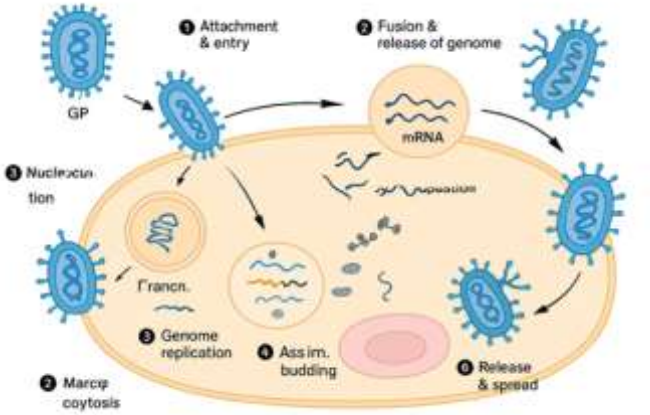
2012	Uganda (Kabale District)	15	4			
2014	Uganda (Kasese District)	1	1			
2017	Uganda (Kween District)	3	3			
2021	Guinea (Gueckedou Prefecture)	1	1			
2022	Ghana (Ashanti Region)	3	2			
2023	Tanzania (Kagera Region)	9	6			
2023	Equatorial Guinea	40	32			
2024	Rwanda	66	15		Sudden fever, chills, severe headache, myalgia, nausea, vomiting, diarrhea, conjunctivitis, rash; later hemorrhage and multi-organ failure	Supportive Care (No licensed antivirals yet), IV fluids and electrolyte correction, Blood transfusions for hemorrhage and anemia, Oxygen therapy ,Analgesics and antipyretics, Strict infection control & barrier nursing
2025	Kagera region, Tanzania,	10	10		Same as above	Same as above

Fig 2. Life Cycle of Marburg Virus



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1. **Attachment & Entry**
    a. The virus attaches to host cells (mainly monocytes, macrophages, dendritic cells, and endothelial cells) via **glycoprotein (GP)** binding to cellular receptors.
    b. Entry occurs through **macropinocytosis** (cell drinking process).
2. **Fusion & Release of Genome**
    a. Viral and endosomal membranes fuse, releasing the **negative-sense single-stranded RNA genome** into the cytoplasm.
3. **Transcription & Translation**
    a. The **RNA-dependent RNA polymerase (L protein)** transcribes viral genes into mRNA.
    b. Viral proteins (nucleoproteins, matrix proteins, glycoproteins, polymerase co-factors) are synthesized by host ribosomes.
4. **Genome Replication**
    a. Once enough proteins accumulate, the viral RNA is replicated into new genomes.
    b. Nucleoproteins encapsidate the RNA to form nucleocapsids.
5. **Assembly & Budding**
    a. Viral proteins and nucleocapsids assemble at the host cell membrane.
    b. Virions bud off the cell, acquiring their lipid envelope containing viral glycoproteins.
6. **Release & Spread**
    a. Newly formed virions are released into the bloodstream, infecting more cells and spreading systemically, causing severe hemorrhagic fever[32] [33] [34].

Fig. 3 Example of Marburg virus

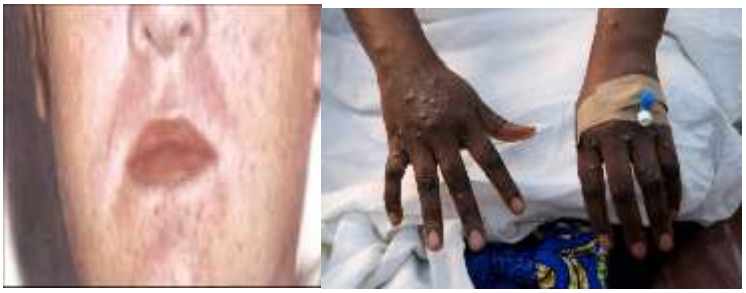

Fig. 4,5 Maculopapular rashes in Marburg disease

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TABLE 5 Structural comparison of MARV vs EBOV glycoproteins with implications for vaccine design

feature	Marburg disease virus	Ebola virus	Lassa fever
Incubation period	2–21 days	2-25 days	6–21 days
Primary reservoir	Fruit bats (Rousettus spp.)	Fruit bats (various sp)	Multimammate rat(Mastomys sp.
Mode of transmission	Contact with bats, primates, body fluids	Contact with body fluids, outbreak	Inhalation/ingestion of rodent excreta, body fluids
Case fatality rate	24–88%	25–90%	1–15% (higher in hospitalized cases)
Diagnostics	RT-PCR, Antigen RDT (2024 advances)	RT-PCR, Antigen RDT	RT-PCR, ELISA antigen/IgM
Treatment / Vaccine	No licensed vaccine; supportive care	Licensed rVSV-ZEBOV vaccine + supportive care	Ribavirin (some benefit); no licensed vaccine

A) Emerging Therapeutic Strategies and Vaccine Development:

There are currently no approved antiviral drugs specifically for MVD, but several therapeutic strategies are under investigation. Monoclonal antibody (mAb) therapies have shown promise in animal models and are currently undergoing clinical trials. One mAb therapy, REGN3470-3471-3479, has shown efficacy in neutralizing MARV and is undergoing Phase I trials. The cAd3-MARV vaccine is safe, well tolerated, and capable of eliciting durable humoral and cellular immunity in humans. These findings represent a critical step toward emergency-use vaccine readiness against MVD, particularly in outbreak-prone regions[1].

Vaccine development has also made significant progress. A recombinant adenovirus-vectored vaccine (Ad26.Marburg) has shown positive results in preclinical trials and is currently undergoing clinical testing. Additionally, DNA-based vaccines and protein subunit vaccines are being explored as potential preventive measures against MVD [35][36][37][38].

B) Supportive management was initiated:

1. **Fluid and electrolyte replacement** to manage dehydration and shock
2. **Blood transfusions** for severe hemorrhage and anemia
3. **Analgesics and antipyretics** for pain and fever control
4. **Oxygen therapy** for respiratory distress

C) Infection control:

Effective infection-prevention and control (IPC) is essential for protecting healthcare workers (HCWs) managing Marburg Virus Disease, given its high transmissibility through blood and body fluids. Key protocols include:

1. Early Identification and Isolation
    a. Suspected cases should be triaged rapidly and placed in designated isolation units with restricted access.
2. Personal Protective Equipment (PPE)
    a. HCWs must use full PPE including gloves, impermeable gowns, N95 or higher-level respirators, face shields/goggles, and boots.

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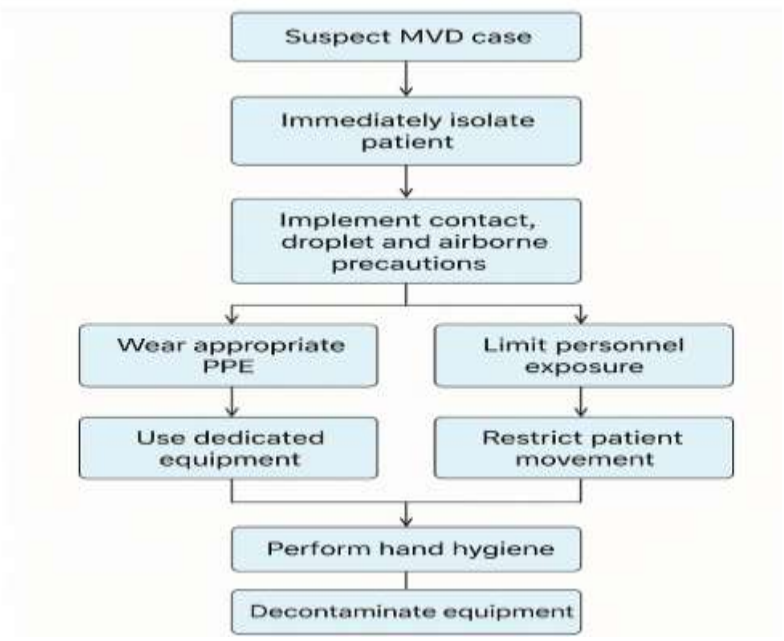
b. Proper donning and doffing procedures must be strictly followed under supervision.

3. Hand Hygiene
    a. Frequent hand washing with soap and water or alcohol-based rubs before and after all patient contact, PPE removal, and contact with potentially contaminated materials.
4. Barrier and Reverse-Barrier Nursing
    a. Limit the number of staff caring for each patient.
    b. Use dedicated equipment and avoid reuse of PPE and disposables.
5. Safe Waste Management
    a. All contaminated waste (sharps, linens, medical devices) should be disposed of in biohazard containers and incinerated or safely buried.
6. Environmental Cleaning
    a. Regular disinfection of patient areas with chlorine-based or other approved disinfectants.
7. Staff Health Monitoring
8. Daily temperature checks and symptom monitoring for exposed HCWs, with clear protocols for post-exposure management.
9. Psychosocial Support
    a. Provide mental health support and counseling for HCWs working under high stress and risk[21][30][39][40]

Fig 6 Schematic of infection-prevention protocols for healthcare workers managing MVD cases



CONCLUSIONS AND FUTURE DIRECTIONS

This case illustrates the devastating course of Marburg Virus Disease, characterized by rapid progression, high fatality, and the absence of definitive therapy. Lessons drawn from this case highlight several priorities for the

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scientific and public health community:

1. Acceleration of translational research on vaccines and monoclonal antibodies, informed by comparative filovirus studies.
2. Deployment of field-ready diagnostic platforms to reduce delays in detection and isolation.
3. Strengthening infection-prevention training and ensuring adequate PPE for healthcare providers.
4. Policy initiatives to guarantee equitable access to emerging therapeutics and vaccines in outbreak-prone regions.
5. Deeper pathogenesis studies to elucidate host–pathogen interactions unique to MARV, which may inform targeted therapeutic approaches.

ACKNOWLEDGMENT

We acknowledge the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), and other international health agencies for providing timely data and outbreak reports that have been invaluable in the preparation of this review. Special thanks are also extended to colleagues, peer reviewers, and mentors for their constructive insights and encouragement throughout the development of this manuscript. Above all, we recognize the healthcare workers on the frontlines who continue to provide care and support to patients affected by emerging infectious diseases such as Marburg Virus Disease.

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ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

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