

Narrative review of Middle East respiratory syndrome coronavirus (MERS-CoV) infection: updates and implications for practice

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Abstract

Human coronaviruses (HCoVs) comprise six subtypes of coronavirus that are associated with a number of respiratory diseases such as common cold, pneumonia, and bronchitis. Middle East respiratory syndrome coronavirus (MERS-CoV) is one of these six HCoV subtypes. HCoVs can result in life-threatening respiratory diseases, such as pneumonia and bronchiolitis, and may cause enteric and neurologic diseases, especially in immunocompromised patients. This narrative review aimed to enrich the knowledge of health care professional regarding MERS-CoV infection epidemiology, control, and management. This review discusses MERS-CoV prevalence, clinical manifestation, modes of transmission, control measures, and management, which we identified in a search of various databases, related journals, and the published literature. It has been shown that MERS-CoV infection is likely to be transmitted among countries. Therefore, countries with a high rate of MERS-CoV infection are urged to develop and implement guidelines to minimize the spread of infection. Countries must give careful consideration to raising public awareness in regions that are affected by MERS-CoV infection and the importance of reporting any disease signs and symptoms, to receive proper care.

Keywords

MERS CoV, coronavirus, Middle East respiratory syndrome coronavirus, respiratory illness, transmission, infection control and management

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Introduction

Human coronaviruses (HCoVs) comprise six subtypes: HCoV-229E, HCoV-NL63, HCoV-OC43, HCoV-HKU1, severe acute respiratory syndrome coronavirus (SARS-CoV), and Middle East respiratory syndrome coronavirus (MERS-CoV). HCoVs are associated with a number of respiratory diseases including common cold, pneumonia, and bronchitis.^{1,2} Investigations have identified four genera of coronavirus: alpha, beta, gamma, and delta CoVs; each subgroup has serotypes that have been found to affect animals or humans.³

HCoVs can result in life-threatening respiratory diseases, such as bronchiolitis, and may also cause enteric and neurologic diseases, especially in immunocompromised adults, children, elderly people, and pregnant women.⁴ In 1960, CoV was first identified as a cause of the common cold.³⁻⁶ Beginning in 2002, an outbreak of severe acute respiratory syndrome (SARS) affected more than 1000 patients, primarily in several countries of Asia, with a high mortality rate.³⁻⁶ The first case of MERS-CoV infection in Saudi Arabia was reported on June 13, 2012 in the city of Jeddah.³⁻⁷ Cases of MERS-CoV infection were subsequently reported in nearly every region of Saudi Arabia; however, the most commonly affected cities were Jeddah, Makkah, Riyadh, and Al-Hassa.⁷

The outbreak of MERS-CoV infection in Saudi Arabia resulted in many infected individuals and deaths. The virus spread to nearby countries in the Middle East including Qatar, Bahrain, Kuwait, Tunisia, and Jordan.⁸ The outbreak also spread to Europe, North Africa, Southeast Asia, and the United States via infected travelers who had visited the Middle East.⁸ Many cases of infection and numerous deaths were reported among clinical health care providers who came into direct contact

with infected patients in clinical settings.⁷ A total of 1227 MERS-CoV cases were recorded in Saudi Arabia from June 2012 to December 2015; of these, 728 patients recovered and 549 died owing to MERS-CoV infection.⁷

The World Health Organization (WHO) stated in September 2018 that MERS-CoV infection had been identified in about 27 countries, with 2260 confirmed cases and a total 803 deaths.⁸ Hospitals that reported outbreaks were shut down as they were unable to accept any more patients. The outbreak necessitated strict contact precautions to be implemented in health care facilities, including isolation of infected patients and the use of personal protective equipment (PPE) such as gloves, N95 respirator-type masks, and gowns.^{5,6} An awareness campaign about MERS-CoV was initiated and directed by the Saudi Ministry of Health.⁹ All primary, secondary, and tertiary health care facilities, as well as public health officials, participated in the campaign.⁹ The aim of the campaign was to educate the Saudi population and to broaden knowledge and prevention strategies via lectures, brochures, and social media. Critical patients with MERS-CoV infection often require admission to intensive care units (ICU) and intubation for a long period.⁹ Prolonged stay in the ICU environment is associated with extreme mental and physical distress, anxiety, nightmares, and respiratory distress.^{10,11} Prolonged intensive and respiratory therapy in the ICU has been reported to be associated with serious psychological impairment and a high prevalence of post-traumatic stress disorder.¹¹ MERS-CoV infection events involve serious threats to one's own physical integrity as well as fear, anxiety, and helplessness.¹⁰ This review aimed to update the knowledge about MERS-CoV infection to increase understanding of its control and management.

Literature search

This narrative review discusses the relevant literature, including updated studies, and the implications for practice with respect to Middle East respiratory syndrome coronavirus (MERS-CoV) infection. We performed a literature search using ProQuest, MEDLINE, and UpToDate. The search was restricted to articles between 2003 and 2019. The search terms used were “Middle East respiratory syndrome coronavirus”, “MERS CoV”, “Coronavirus”, “respiratory illness”, “transmission”, and “infection control and management” which yielded 535 results. After applying the inclusion criteria, there were 268 articles remaining. After reading the article titles and abstracts, 50 studies remained. Finally, after reading the full text, we included 22 articles based on the quality of the studies.

Prevalence of MERS-CoV

During the MERS-CoV outbreak, cases of MERS-CoV infection were reported in 27 countries, among which 12 were located in the Eastern Mediterranean region.¹¹ Although this virus spread throughout the Middle East, most confirmed cases (n=1882) were in Saudi Arabia with 729 deaths, comprising a fatality rate of 38.7%.¹¹ Cases outside the Middle East most often occurred among travelers who had visited the region.

Clinical manifestation

The symptoms observed among documented cases of MERS-CoV infection comprise cough, fever, rhinorrhea, shortness of breath, gastrointestinal symptoms, nausea, vomiting, fatigue, and myalgia.^{7,12} In severe cases, MERS-CoV infection causes respiratory failure. However, some confirmed cases have been asymptomatic.¹² Individuals aged

between 50 and 59 years are at higher risk of acquiring primary infection and death whereas individuals aged 30 to 39 years have a high risk of secondary infection.¹³ MERS-CoV causes more severe complications in immunocompromised patients with a history of diabetes, renal failure, and lung diseases because these individuals are more prone to acquiring the infection.¹³

Modes of transmission

Growing evidence suggests that the dromedary camel and bats serve as MERS-CoV reservoirs and can transmit the infection to humans.^{8,14} However, epidemiologically, camels are more likely to be the main source of infection in humans.^{7,8,14} Based on investigations conducted in several countries, including Europe and South Africa, fecal samples of some species of bats were found to have a high viral load of MERS-CoV.^{3,15} However, the species tested were different than the existing species in Saudi Arabia, where the outbreak occurred.^{3,15} In recent studies on dromedary camels in Middle Eastern countries such as Saudi Arabia, Egypt, Oman, and the United Arab Emirates, lung and nasal swab samples from dromedary camels have tested positive for MERS-Cov.¹⁶⁻²¹ In some studies, the percent positivity in tested camels reached 98% to 100%.³

MERS-CoV can be transmitted via airborne particles from one infected patient to another. The main mode of human-to-human transmission is by direct contact with an infected patient or infectious respiratory droplets.¹⁶ Many reported cases of MERS-CoV infection have resulted from person-to-person transmission of the virus in hemodialysis units, ICUs, and other inpatient units in different health care settings.¹⁶ Human-to-human transmission of the virus can occur directly via inhalation of aerosol droplets transmitted through

coughing or sneezing. Indirect transmission results from contact with contaminated materials such as surfaces, equipment, and devices. The average incubation period of MERS-CoV is about 5.2 to 12 days.⁸

Control measures

The main control measure is adoption of contact and airborne precautions.¹² It is also recommended that droplet precautions be adopted when dealing with patients who have acute respiratory infection.¹² To prevent the spread of MERS-CoV infection, measures that must be applied include the use of PPE, gowns, and gloves as contact precautions and use of surgical masks and N95 masks as droplet precautions.¹² Specific additional precautions and measures must be applied during aerosol-generating procedures such as patient airway suctioning, application of high-flow nasal oxygen, bronchoscopy, intubation, and cardiopulmonary resuscitation. Extra precautions needed in these situations include use of an N95 respirator or powered air-purifying respirator and wearing an isolation gown, goggles or face shield, and gloves.¹⁸ To control the disease in countries with a high prevalence of MERS-CoV infection, local health authorities must enforce adherence to appropriate precautions when dealing with MERS-CoV-infected patients.⁸

In many Gulf countries, animals are valuable sources of milk and meat. The trading of infected animals, especially camels, is a potential source for the spread of MERS-CoV infection to other countries. This factor encouraged establishment of the One Health Working Group, to control and prevent the transmission of MERS-CoV.²² In collaboration with the WHO and Food and Agriculture Organization of the United Nations, workshops in the application of One Health approaches were conducted in Qatar in 2015, with representation from

Saudi Arabia, Kuwait, United Arab Emirates, Bahrain, Oman, Egypt, and Jordan.²² A survey was distributed to evaluate the preparedness of these countries in controlling MERS-CoV. The survey assessed several crucial elements such as leadership and coordination, preparedness and response planning, epidemiological surveillance systems, and laboratory diagnostic capabilities.²² This survey highlighted some major challenges in these countries, such as limited budgets and technical needs for surveillance, diagnosis, and research; a lack of skilled manpower; and denial among camel breeders about the risk of infection and transmission of the disease.²² Proper adoption of the One Health model is a promising approach for better control of MERS-CoV infection.

Management

The understanding of CoV has evolved over time, from that of a simple virus causing flu-like symptoms in 1960, to its identification as a more serious virus causing SARS in 2002 to 2003, and finally to that of a severe threat that caused the MERS outbreak in Saudi Arabia in 2012.⁷ To date, the main management strategy in MERS-CoV is administration of antipyretics and analgesics, maintenance of hydration, and respiratory support via mechanical ventilation or extracorporeal membrane oxygenation. If a patient with MERS-CoV has bacterial coinfection, treatment is directed toward the use of antibiotics.¹⁵ Some medications have proven to be more beneficial when started early, such as ribavirin and interferon alpha, which have been shown to have synergistic effects.¹⁵ Mycophenolic acid has also been shown to be efficacious, but this therapy requires further supportive evidence.¹⁶ Recently, there have been attempts to develop a vaccine against MERS-CoV, but this research is still in experimental stages.¹⁶

Conclusion

MERS-CoV infection is a potentially fatal disease that can be transmitted across countries. Governments in countries with a high rate of MERS-CoV infection are urged to develop and implement guidelines to minimize the spread of infection. Emphasis on strict application of PPE is crucial in limiting hospital-acquired infection and the spread of infection when handling patients with suspected MERS-CoV infection. It is also important to raise awareness among travelers to regions affected by MERS-CoV about the signs and symptoms of the disease and to urge individuals to report any of these signs and symptoms so as to receive proper and timely care.

Author contributions

AA – conception, proposal, data collection and analysis, and manuscript preparation

ZA – data collection and analysis and manuscript preparation

Declaration of conflicting interest

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