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Management of acute coronary syndrome during the MERS-CoV outbreak – Single center experience

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ABSTRACT

Background: During the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak of 2014, tertiary care cardiac centers shouldered the responsibility of caring for patients presenting with Acute Coronary Syndromes (ACS). This entailed designing algorithms that ensured timely management of patients with ACS in the setting of an emerging novel viral infection that was rapidly spreading within the community with a high infectivity and case fatality rate. The objective of this study is to describe a single center experience and the adopted pathway for the management of ACS.
Methods: This is a single center retrospective observational study of all patients who were admitted between March 1, 2014 and May 31, 2014 with an ACS. Total ACS admissions, bed turnover, procedures and healthcare personnels' infection rates were obtained from the annual statistics database and employee health records. All baseline characteristics, therapy received, outcomes and MERS-CoV status were obtained from the chart review.
Results: A total of 148 patients with a diagnosis of ACS were admitted during that period of time. Of those, 59 had STEMI, 42 had NSTEMI and 47 had unstable angina. PCI was performed in 74, coronary artery bypass grafting (CABG) in 28 and conservative therapy was prescribed for 46 patients. The bed turnover was no higher than the previous or subsequent two months suggesting no change in practice. The infection rate of MERS-CoV was zero for healthcare workers.
Conclusions: In times of a national health crisis it is imperative that best practices are upheld to sustain existing resources, reduce bed occupancy and preserve medical personnel. A key component of such a strategy depends on assigning centers dedicated to isolating and treating the highly infectious disease outbreak while allowing other centers to provide expeditious cardiac care.

1. Introduction

Response to novel or emerging infectious diseases is one of the most difficult challenges facing public health systems. The goals of any public health establishment are twofold: limit transmission of the infection to the public and healthcare personnel and deliver appropriate and timely care to patients with other non-communicable diseases including acute coronary syndromes (ACS). This requires adherence to isolation protocols, provision of personal protective equipment (PPE) and rapid bed turnover to accommodate new cases and protect established ACS cases from acquiring the infection during hospitalization. In addition, it is vital to reserve intensive care beds for those who require ventilation, extracorporeal membrane oxygenation (ECMO) or other forms of circulatory support. To date, there is paucity of evidence and guidelines that can be referenced to streamline care for individuals presenting with ACS during an outbreak. Here we describe a single center experience, King Fahd Armed Forces Hospital's Cardiac Center (KFAFH), during the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak of 2014. MERS-CoV is a corona viral infection that was first identified and reported in Saudi Arabia to the World Health Organization (WHO) in September 2012. This was primarily a lower respiratory tract infection with a case fatality rate of 34.4%, Basic Reproductive number of 0.3–0.8 and a mean incubation period of 6 days [1–5]. A pathway for the management of ACS was designed by the Cardiac Center that ensured timely intervention for those who were at high risk while complying with the infection control measures outlined by the Ministry of Health (MOH). Of note, the MOH designated hospitals to care for those with a confirmed MERS-CoV infection. This allowed tertiary care cardiac centers to maintain a low admission rate of infected cases and to continue to manage acute cardiac conditions in accordance with established guidelines.

2. Methods

This is a single center observational study of all patients who were admitted to the Cardiac Center of King Fahd Armed Forces Hospital

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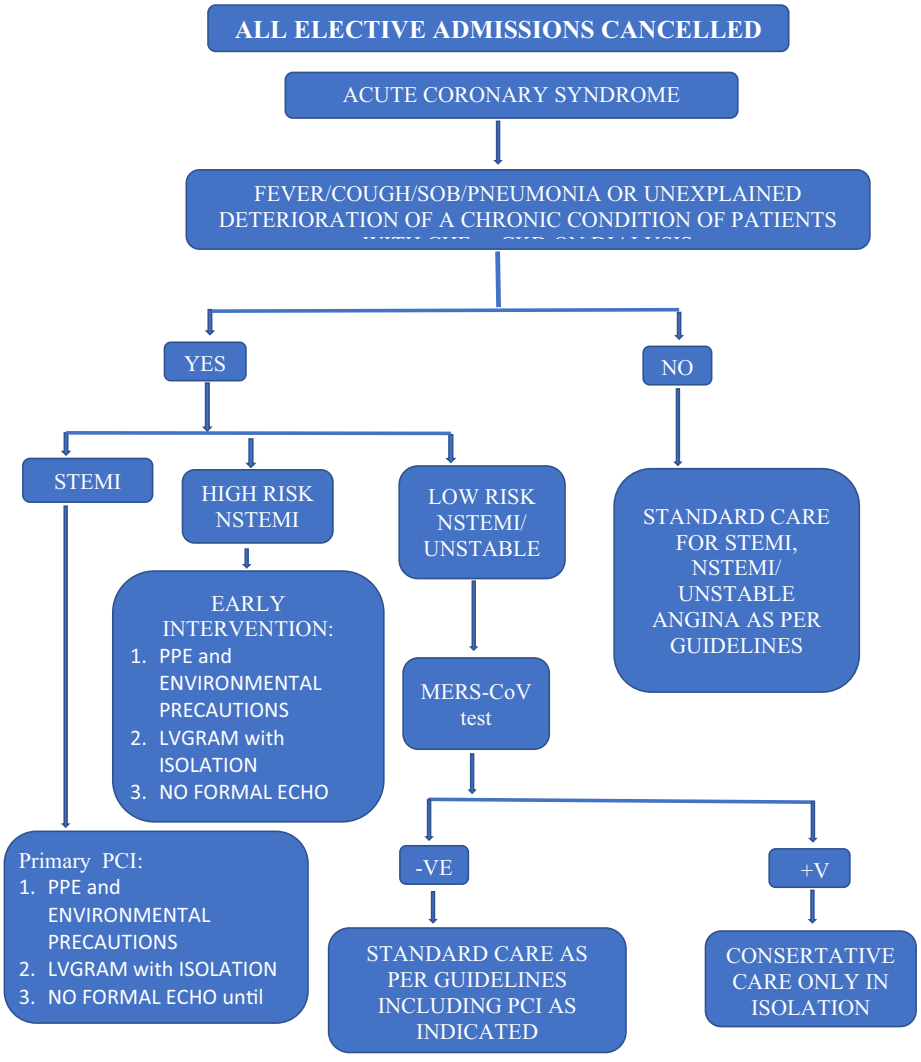
between March 1, 2014 and May 31, 2014 with an ACS. After obtaining approval from the institution's ethics committee, the data was collected retrospectively. Total ACS admissions, bed turnover, procedures and healthcare personnel' infection rates were obtained from the annual statistics database and employee health records. All baseline characteristics, therapy received, outcome and MERS-CoV status were obtained from the chart review. In terms of outcomes, death and NYHA class III or IV heart failure were recorded at thirty days. The ACS protocol adopted at that time is defined in Fig. 1. All elective admissions to the cardiac center were cancelled. The MOH designated MERS-CoV hospitals in the Western region of Saudi Arabia where all patients with confirmed MERS-CoV cases were referred for isolation and further care. KFAFH was not a designated MERS-CoV center, nevertheless as the major tertiary cardiac center in the region, patients were referred from all outlying hospitals and facilities who required cardiac care irrespective of their MERS-CoV status.

Overall, patients presenting to KFAFH's emergency room or referred directly to the center with an ACS were screened for MERS- CoV symptoms in particular fever, cough and shortness of breath. Those with a suspicion based on symptoms or referral source were placed in isolation and a screening test was requested. The MERS-CoV polymerase chain reaction (PCR) was sent to the regional laboratory with results obtained in 48 h. However, irrespective of MERS-CoV symptoms, all ST elevation myocardial infarction (STEMI) patients continued to be treated with primary percutaneous coronary interventions (PCI). During the PCI, staffing was minimized to the operator, scrub nurse, circulating nurse and radiographer. All staff wore the WHO recommended PPE including an N95 mask. No trainees were involved in these cases. The patient was transported with a regular surgical mask directly to the one designated catheterization laboratory bypassing the holding and recovery areas. A limited echocardiogram or left ventriculography was performed in the catheterization laboratory. After the procedure, the patient was directly transported to the isolation room in the coronary care unit where the standard MERS-CoV screening was conducted through a nasal swab. Once the PCR result was negative, the patient was released from the isolation room at which time a formal department echocardiogram could be conducted. Non-STEMI (NSTEMI) patients with a high Grace (Global Registry of Acute Coronary Event) score. Those with a score greater than 140 were assigned to an early invasive strategy (12–24 h). During the 12–24 h, a screening test was usually obtained; nevertheless, results were not awaited and the decision to proceed with invasive angiography was not determined by a negative result. The procedure and



Abbreviations: STEMI: ST Elevation Myocardial Infarction, NSTEMI: Non-ST Elevation Myocardial Infarction, PCI: Percutaneous Coronary Intervention, PPE: Personal Protective Equipment

Fig. 1. Acute coronary syndrome protocol.

transportation protocols were similar to that for STEMI as described above. For any low risk NSTEMI or unstable angina patient, the results of MERS-CoV screening dictated further cardiac evaluation. Patients with negative screening tests were treated with standard guideline directed PCI. Those who were positive were treated conservatively. All low risk patients had a formal echocardiogram after the screening test results were obtained. In case of a positive screening test, the sonographers wore the appropriate PPE and performed a limited study.

2.1. Statistical analysis

In this retrospective analysis the continuous variables are presented as mean and range. The qualitative variables are presented in percentages. The bed turnover rate was calculated with the standard formula of number of discharges in a month/number of beds during that month.

3. Results

The MERS-CoV outbreak occurred in Saudi Arabia between March and June 2014. It was contained by June 2014 after which all isolation and preventive measures were lifted with resumption of normal hospital services that were previously suspended. The burden of MERS-CoV cases in the cardiac center remained lower than that in MOH facilities only accounting for less than 5% of the total positive cases reported in the Western Region for that time. Upon comparing data from 2013, the year preceding the MERS-CoV outbreak, there was an approximately 70% reduction in all ACS admissions. There was no apparent difference in the distribution of unstable angina, NSTEMI and STEMI compared with the previous year nor was there an apparent difference in presentation by gender compared with the previous year. The baseline characteristics of patients who were admitted during that period are detailed in Table 1. A total of 148 patients with a diagnosis of ACS were admitted during that period of time. The majority, 84%, were men. The average age was 59 years (range 26–84 years). A quarter of those had three or more atherosclerotic cardiovascular risk factors (ASCVD). Of those, 59 had STEMI, 42 had NSTEMI and 47 had unstable angina. PCI was performed in 74, coronary artery bypass grafting (CABG) in 28 and conservative therapy was prescribed for 46 patients. All 59 STEMIs met the guideline recommendation of a door to balloon time of less than 90 min. A total of 32 were anterior, 15 were inferior and 12 were lateral/other. There were a total of 3 mortalities, two of whom were STEMIs (all were anterior myocardial infarctions) later complicated by fever, acute respiratory distress syndrome (ARDS) and shock with a protracted hospital stay (16 and 30 days). Neither was confirmed to be MERS-CoV. The third was a NSTEMI with multiple comorbidities including chronic kidney disease and went into refractory heart failure. All three patients had severe left ventricular systolic dysfunction (ejection fraction (EF) 25–30%). Four patients had class III-IV NYHA heart failure upon follow up in the clinic (EF 30–35%). The average length of in-hospital stay was 4.5 days (4.7 STEMI, 6.5 NSTEMI, and 3.3 unstable angina). Most patients arrived with an unknown MERS-CoV status; however, the majority had no fever or respiratory symptoms suggestive of a MERS-CoV infection.

The bed turnover rate for March 2014 was 5.9, April 5.0 and May was 5.7. The bed turnover was no higher than the previous or subsequent two months suggesting no change in practice. These turnover rates were primarily driven by the CABG patients who usually have a longer length of stay.

Upon reviewing the records of healthcare employees, the infection rate of MERS-CoV was zero for nurses, physicians, radiographers, and cardiovascular technologists. All these staff members participated directly in-patient care in the coronary care unit, catheterization laboratory and the non-invasive laboratory.

Table 1
Baseline characteristics.

General characteristics	$N = 148$ (%)
Age (years)	Range 26–84 (Mean 59)
Gender - Female	24 (16%)
ASCVD risk factors	Three risk factors 37 (25%)
Co-morbidities: COPD, renal impairment, previous MI	41 (28%)
Presentation of ACS	
STEMI	59
NSTEMI	42
Unstable angina	47
Assigned treatment strategy	
PCI	74
CABG	28
Conservative	46
EF (mean)	Range 15–75% (Mean 46%)
Length of hospital stay	1–33 days (Mean 4.5 days)
STEMI	Mean 4.7 days
NSTEMI	Mean 6.5 days
Unstable angina	Mean 3.3 days

Abbreviations:
ASCVD: Atherosclerotic Cardiovascular Disease, COPD: Chronic Obstructive Pulmonary Disease, MI: Myocardial Infarction, STEMI: ST Elevation Myocardial Infarction, NSTEMI: Non-ST Elevation Myocardial Infarction, PCI: Percutaneous Coronary Intervention, CABG: Coronary Artery Bypass Grafting, EF: Ejection Fraction.

4. Discussion

This was a unique experience that offered a pathway that was safe for both patients presenting with an ACS requiring guideline directed therapy and the healthcare personnel tasked with providing expeditious care. Defining the coronary anatomy of ACS patients allowed timely intervention and early discharge without compromising the quality of cardiac care or exposing patients to an unnecessarily prolonged hospital stay. This was noted in the bed turnover rate that remained unchanged during the outbreak. This pathway provides some insights into management of ACS during serious infectious disease outbreak such as the current COVID-19 (SARS CoV2) pandemic. There are, however, significant differences between these corona virus outbreaks (Image 2) [6]. Firstly, MERS-CoV had a lower infectivity, but a much higher case fatality [5–6]. The infectivity rate in particular has a direct impact on the number of patients any healthcare system is required to accommodate, the safe transfer of cases between facilities and the availability of beds. It also significantly impacts the transmission to healthcare workers who may become sick or quarantined. Another important notable difference between the two infections is that with MERS-CoV most patients were highly symptomatic and easily identifiable thereby increasing the sensitivity of screening procedures. On the contrary, with COVID-19 approximately 81% had mild symptoms in the Chinese reports [7]. Mildly symptomatic patients may not be easily identifiable on screening procedures.

Zeng et al. published a clinical pathway for patients with an acute myocardial infarction and COVID-19 (SARS CoV2) in the Sichuan Provincial People's Hospital [8]. There were two key differences in their proposed pathway and the one described in this cohort. Firstly, the Chinese model starts with a rapid nucleic acid test with a built-in time delay to discriminate between positive and negative individuals. The other difference is that the primary strategy for STEMI patients in the Chinese model was thrombolytic therapy and not primary PCI as recommended by the current guidelines irrespective of the COVID-19 status. Furthermore, if patients had severe pneumonia, they were assigned to conservative therapy that did not include thrombolysis which again does not conform to current STEMI guidelines. As for NSTEMI patients, viral screening was prioritized over ACS risk scores. If a patient was positive for COVID-19, conservative therapy was recommended irrespective of the ACS risk score. Only those with a negative viral screen underwent further stratification and revascularization as appropriately

recommended in the guidelines. Unfortunately, Zeng et al. do not provide cardiovascular outcomes for their cohort.

More recently, the American College of Cardiology and the Society of Cardiovascular Angiography and Interventions released a joint statement on procedures in the catheterization laboratory during the COVID-19 pandemic [9]. They suggest it is reasonable to suspend elective procedures including endovascular and structural interventions to preserve beds which is exactly the protocol applied for the KFAFH cohort. For STEMIs they recommend primary PCI with precautions similar to the KFAFH protocol. In addition, the statement emphasized the use of Powered Air Purifying Respirator (PAPR) systems especially for patients who may require CPR and/or intubation. Since most labs have either normal (as is the case in KFAFH) or positive ventilation systems that are not designed for infection isolation, they recommend terminal cleaning. Finally, for NSTEMIs the statement recognizes that there is usually ample opportunity to screen for COVID-19 before coronary angiography. The KFAFH protocol differentiates between low and high risk NSTEMI. For low risk NSTEMI, the protocol was similar to the ACC/SCAI statement recommending screening beforehand. For high risk NSTEMI, the KFAFH protocol followed an early invasive strategy without waiting for the MERS-CoV screening status because it took 48 h and would delay intervention and extend hospital stay.

4.1. Limitations

The primary limitation; however, is that this was a single center experience that may not be representative of all public or private hospitals in Saudi Arabia. In addition, there is a referral bias as this was not one of the MOH designated centers for the care of MERS-CoV patients. Hence, exposure of the staff remained comparatively low. On the other hand, this is a tertiary cardiac center to which ACS cases were regularly transferred for further care irrespective of the MERS-CoV screening status. Cases were referred from all hospitals including the MOH hospitals which were receiving febrile individuals with suspected MERS-CoV infections. All patients were managed in accordance with the proposed algorithm. This model was successful in the setting of a government mandated designation of MERS-CoV hospitals which allowed other public hospitals to continue to provide uninterrupted tertiary care for non-MERS-CoV illnesses such as ACS. There was, however, a notable decrease in the overall number of patients presenting to the emergency room or referred with ACS (including STEMIs) during this time period. This was consistent with the observed trend of an overall reduction in patient encounters across all specialties. The trend was primarily a direct consequence of reluctance of patients to report to hospitals during the outbreak.

5. Conclusion

Maintaining accepted standards of care for cardiac patients has proven to reduce mortality and morbidity. We believe this benefit should not be sacrificed because of a concurrent competing health crisis. In times of a national health crisis it is imperative that best practices are upheld to sustain existing resources, reduce bed occupancy and preserve medical personnel. A key component of such a strategy depends on assigning centers dedicated to isolating and treating the highly infectious disease outbreak while allowing other centers to continue to provide expeditious cardiac care. This policy ensures a low infectivity rate of staff and other patients. Such a policy may prove to be ideal in the current COVID-19 outbreak unless all the healthcare systems become overwhelmed and must share the burden of infected patients.

References

[1] Giovanni R, Adallat M, Abroug F, AlDhahery S, AlHajri M, Al-Hakeem R, et al. State of knowledge and data gaps of Middle East respiratory syndrome coronavirus (MERS-CoV) in humans version 1. PLoS Curr. 2013 November 12;5 ecurrents.outbreaks.

[2] Lessler J, Rodriguez-Barraquer I, Cummings D, Garske T, Van Kerkhove M, Mills H, et al. MERS-CoV scenario modeling working group. Estimating potential incidence of MERS-CoV associated with Hajj pilgrims to Saudi Arabia 2014. PLOS Curr Outbreak. 2014;11(24):1–3.

[3] Zaki AM, van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier RA. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. N Engl J Med. 2012 Nov;367(19):1814–20.

[4] Assiri A, McGeer A, Perl TM, Price CS, Al Rabeeah AA, Cummings DA, et al. Hospital outbreak of Middle East respiratory syndrome coronavirus. N Engl J Med. 2013 Aug 1;369(5):407–16.

[5] Barry M, Al Amri M, Memish Z. COVID-19 in the shadows of MERS-CoV in the Kingdom of Saudi Arabia. J Epidemiol Glob Health. 2020 Mar;10(1):1–3.

[6] Iwasaki, Akiko (@VirusesImmunity). "With #COVID19 With its Lethality Rate, the Only Safe Way to Achieve Herd Immunity is Through Vaccination." 18/03/2020,19:03. Tweet.

[7] Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, evaluation and treatment coronavirus (COVID-19). StatPearls. 2020:1–20 Jan-.2020 Mar 8.

[8] Zeng J, Huang J, Pan L. How to balance acute myocardial infarction and COVID-19: the protocols from Sichuan Provincial People's Hospital [published online ahead of print, 2020 Mar 11]. Intensive Care Med. 2020:1–3.

[9] Welt F, Shah P, Aronow H, Bortnick A, Henry T, Sherwood M, et al. Welt FGP, Shah PB, Aronow HD, et al. catheterization laboratory considerations during the coronavirus (COVID-19) pandemic: from the ACC's interventional council and SCAI. J Am Coll Cardiol. 2020;75(18):2372–5.