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Management of Patient Flow in Vascular and Interventional Radiology During MERS-CoV Outbreak

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A B S T R A C T

In 2015, an outbreak of Middle East respiratory syndrome coronavirus occurred in Saudi Arabia and necessitated special measures to be implemented to control the spread of the virus. In this article, we will discuss how the outbreak was managed in the vascular and interventional radiology (VIR) suite in a large tertiary care hospital in Saudi Arabia. Various measures were taken to reduce the risk of transmission of infection. Unit-level education played an important role in the care of patients. A hospital-wide educational program was implemented to ensure zero transmission of infection. Special attention was made to monitor staff who acquired the virus. VIR suite was able to handle the situation and control the outbreak.

Introduction

Middle East respiratory syndrome coronavirus (MERS-CoV) is a viral respiratory disease caused by novel coronavirus. The World Health Organization's (WHO) current understanding is that it is a zoonotic virus that has entered the human population. However, the reason that human cases were first detected only in 2012 is unknown, and the specific exposures resulting in and modes of transmission from animals to humans have not been fully elucidated (MERS, n.d.).

The clinical spectrum of MERS-CoV infection ranges from no symptoms (asymptomatic) or mild respiratory symptoms to severe acute respiratory disease and death. A typical presentation of the disease is fever, cough, and shortness of breath. Pneumonia is a common finding but not always present. Gastrointestinal symptoms, including diarrhea, have also been reported (MERS-CoV, n.d., 2015).

The disease was first identified in 2012 resulting in nine cases worldwide, five of which came from Saudi Arabia, but the massive epidemic occurred in the year 2015, which recorded 1,368 cases, 75% (1,037 cases) from Saudi Arabia (WHO, 2015).

Between August 1, 2015 and October 15, 2015, 136 new MERS-CoV cases were diagnosed in the institution, 43 of them were healthcare workers, and of 60 vascular and interventional radiology (VIR) staff, only one member was diagnosed and without sequela recovered after home isolation.

As of October 16, 2016, there are 1,427 total confirmed cases with 32 asymptomatic, three cases still under treatment, 845 cases recovered, and 611 cases passed away since 2012 (Ministry of Health Saudi Arabia-Statistics, 2016).

Purpose

The purpose of this article is to discuss how we managed the patient flow in the VIR section during the MERS-CoV outbreak to reduce the risk of transmission of infection.

Methods used to control spread

Limit of Patient Flow

From the last week of August 2015 to the beginning of October 2015, all elective inpatient and outpatient procedures were postponed. Only emergent and life-threatening cases were scheduled.

A checklist prepared by the infection prevention and control department was used as criteria for suspecting MERS-CoV (Figure 1).

- Patient name and medical record number were placed in the checklist for tracking purposes.
- Checklists were kept in the unit as a hardcopy file.

All patients who came from the emergency room needing intervention were considered and placed under MERS-CoV precautions, and because there is no negative pressure room in the unit, they were placed last on the list and sent directly inside the VIR room on arrival to the department. No HEPA filters were used,
but instead, the team who took care of these patients followed the proper donning and doffing intended.

**Work shifts**

The VIR team was divided into two shifts. Interventional radiologists, nurses, special procedure technologists, and patient care technicians, alternately working to minimize staff exposure. Contact tracing for the positive MERS-CoV patients was an important part of management, and the nurse manager was in communication with the infection control department daily.

Staff who came in contact with patients inside the facility, probable and/or confirmed cases with or without symptoms, were directly sent for swabbing in the Employee Health Clinic.

**Unit-Level Education**

To ensure staff safety, daily education and reiteration of the important preventative points were done.

**DONNING of PPE**

Before entering the room

1. Perform hand hygiene
2. Don fluid-resistant unsterile long sleeved gown
   (Should fully cover torso from neck to knee and should be secured at neck and waist)
3. Put on a fit tested seal checked N95 mask or PAPR
4. Put on eye protection (goggles or face shield)
5. Put on gloves (Allow to extend over isolation gown)

**DOFFING of PPE**

Before leaving the room

1. Remove gloves
2. Perform hand hygiene
3. Remove goggles or face shield
4. Remove isolation gown (Unfasten ties and peel gown away from the neck and shoulder, turn it inside out, fold into a bundle and discard)
5. Perform hand hygiene
6. Immediately after leaving the room, remove N95 mask or PAPR
   (Hold the band without touching the front side)
7. Perform hand hygiene

**Hand Hygiene**

As hand hygiene is the most effective and simplest way to prevent the spread of infections in the hospital, we wanted to ensure that staff were knowledgeable and well trained on the technique of the five moments of hand hygiene, which are before patient contact, after patient contact, before aseptic task, after handling bodily fluids, and after contact with patient’s surroundings (National

[Figure 1. This is the respiratory checklist used for vascular and interventional radiology outpatients for screening. MERS-CoV = Middle East respiratory syndrome coronavirus; NGHA = National Guard Health Affairs; ER = emergency room; SOB = shortness of breath.]

[Figure 2. The steps for donning personal protective equipments. PAPR = powered air-purifying respirator.]

[Figure 3. The steps for doffing personal protective equipments. PAPR = powered air-purifying respirator.]

[Figure 4. A picture during fit testing for the N95 mask.]
Guard Health Affairs/hand hygiene). Alcohol-based hand rubs (ANIOS by ANIOS Laboratories, France) and soap (Trigon by Evans Vanodine International PLC, England) and water were used for hand hygiene. Regular inservices were conducted to ensure staff awareness and adherence to hand hygiene (Hand hygiene, n.d.).

Donning and Doffing Technique

Personal protective equipment items were very important, especially in handling these cases so the proper steps of donning and doffing were explained thoroughly to reduce the risk of transmitting infection. A special poster was developed to describe the steps of donning (Figure 2) and doffing (Figure 3).

N95 Mask Fit Testing

A mandatory N95 mask fit testing was done (Figure 4) for all the staff in VIR. Any staff member who failed the mask fit test was not allowed to handle probable and confirmed cases. If a staff member failed to fit any of the N95 masks, they were trained to use the special powered air-purifying respirator (PAPR) (Figure 5). The staff can only handle probable and confirmed cases if they passed the N95 fit test or were trained for PAPR use.

Cleaning Manual of Noncritical Items

Cleanliness of items and equipment used in the unit are very important, particularly during a period of virus outbreak. Lists of items and/or equipment to be cleaned as per the cleaning manual provided by infection prevention and control department were given, and each group (nurses, technologists, patient care technicians, and housekeepers) were assigned and taught how to clean the item (Cleaning and disinfecting noncritical items., n.d.; Figure 6). Special labels were placed identifying if the equipment and/or item was cleaned (Figure 7).

Hospital-Wide Education

The hospital went through a major transformation to ensure zero transmission. A mandatory infection prevention and control training and competency program entitled Right Care, Right Now was introduced on September 29, 2015. It is a half day instructional activity comprising lectures and hand-on training. The program is provided in house by the hospital training center. The program was developed to ensure competency in basic knowledge and practice in infection prevention and control, and it was made mandatory for all the health care workers in the hospital. Each staff was scheduled and released by their specific unit managers to attend the training.

The program proved its efficiency by the large number of staff who was trained. A post-training test was introduced, and the staff received a certificate on successfully passing the test.

Conclusion

The MERS-COV epidemic has indeed pressed a great impact not only to VIR suite but also on the whole institution. It showed how

| Non-Critical Care Items | Cleaning Method | Product Use | Frequency | Responsible Person |
|-------------------------|----------------|-------------|-----------|---------------------|
| ACT machine             | Wipe Surfaces  | Alcohol Wipes | Daily     | Nurse/PCT          |
| Cardiac Monitors        | Wipe Surfaces  | Alcohol Wipes | After patient contact | Nurse/PCT         |
| Cuffs and Cables        | Wipe Surfaces  | Alcohol Wipes | After patient contact | Nurse/PCT         |
| ECG cables              | Wipe Surfaces  | Alcohol Wipes | After patient contact | Nurse/PCT         |
| SPO2 Cables             | Wipe Surfaces  | Alcohol Wipes | After patient contact | Nurse/PCT         |
| Glucometer              | Spray with Disinfectant | Alcohol Wipes | After patient contact | Nurse |
| Injector Machines       | Wipe Surfaces  | Alcohol Wipes | Daily     | Technologist/PCT    |

Figure 6. Sample list of noncritical items in angio suite. ACT = activated clotting time; PCT = patient care technician; ECG = electrocardiogram; SPO2 = blood oxygen saturation level.
A number of measures were taken to reduce staff exposure and limit the spread of infection of VIR staff. These measures were very effective in stopping the transmission of the virus.

As of now, all outpatients coming to VIR for procedures are screened using the checklist for respiratory symptoms. Their procedures were postponed if they have two clinical symptoms and are asked to go to emergency department. As for inpatients, they are all screened on their arrival to the emergency department.

The Right Care, Right Now training is to be renewed by the employees every 2 years to ensure the competency of the staff.

The spread of other infections might have been reduced as a result of this program. However, this was not tracked, and it will be the subject of future study.

References

Cleaning and disinfecting noncritical items. (n.d.). Retrieved from http://webapps.ngha.med/applications/manual/Main.aspx.
Hand hygiene. (n.d.). Retrieved from http://portal.ngha.med/sites/Riyadh/ipc/Pages/hand.aspx.
Middle East Respiratory Syndrome. (n.d.). Retrieved from http://www.cdc.gov/coronavirus/mers.
Middle East respiratory syndrome coronavirus (MERS-CoV) fact sheet. (2015). Retrieved from www.who.int/mediacentre/factsheets/mers-cov/en/.
MERS-CoV. (n.d.). Retrieved from http://portal.ngha.med/sites/Riyadh/ipc/diseases/merscov/Pages/default.aspx; http://portal.ngha.med.ca/sites/Riyadh/ipc/diseases/merscov/Pages/default.aspx.
Ministry of Health Saudi Arabia—Statistics. (2016). Retrieved from www.moh.gov.sa/en/CCC/FAQs/Corona/Pages/default.aspx.

Figure 7. Labeling an equipment after being cleaned.