

The development of a protocol for post-mortem management of Ebola virus disease in the setting of developed countries

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Abstract The management of the recent Ebola virus disease (EVD) epidemic continues to pose currently insuperable challenges to health care providers in the resource-deprived countries of West Africa. In an age where air travel facilitates rapid movement of people between countries and continents, there is an urgent requirement for health systems around the globe to develop management strategies and protocols in the event that EVD cases are suspected or confirmed. Departments of forensic pathology play an important, and underestimated, role in public health service delivery, particularly at times of novel infectious disease emergence. This role can include disease identification, characterization, and notification, as well as close engagement with agencies responsible for disease surveillance and treatment provision. A mass outbreak of EVD in the Western world is considered highly unlikely; however, there is clear responsibility on departments of forensic pathology to develop protocols for rapid assessment of sporadic or suspected cases while ensuring the health and safety of mortuary and pathology personnel. The Ontario Forensic Pathology Service and the Victorian Institute of Forensic Medicine have collaborated on the development of a protocol for management of EVD cases presenting at a scene or in the

mortuary. It is hoped that this trans-national, inter-departmental exercise will serve as a model for future co-operative endeavors. The protocol has been distributed to forensic pathology departments around Australia and may be modified to accommodate local resource capabilities.

Keywords Ebola virus · Post-mortem · Management

Introduction

About Ebola virus disease

Ebola virus disease (Ebola; formerly known as Ebola Hemorrhagic Fever) is a severe, often fatal illness with a death rate of up to 90 %. The illness affects humans and non-human primates: monkeys, gorillas, and chimpanzees [1]. Ebola viruses are part of the family of Filoviridae which also includes Marburg virus. Five species of Ebola virus have been identified: Zaire, Sudan, Reston, Tai Forest, and Bundibugyo [2]. The origin of the virus is unknown but fruit bats (Pteropodidae) are considered the likely host of the Ebola virus, based on available evidence [1].

Transmission of Ebola virus disease

Ebola virus disease is introduced into the human population through close contact with secretions, organs, blood or other body fluids of host species or infected animals. In Africa, infection has occurred through the handling of infected chimpanzees, gorillas, fruit bats, monkeys, forest antelope, and porcupines found ill or dead in the rain forest. It is important to reduce contact with high risk animals (e.g. fruit bats, monkeys or apes), such as not picking up dead

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animals or handling their raw meat [1]. Airborne transmission, as occurs for measles or smallpox, has never been documented [2].

Once a person is infected, Ebola virus can spread to others from direct contact with the infected person's blood or other body fluids or secretions (stool, urine, saliva, semen) through broken skin or intact mucus membranes. Infection can also occur if broken skin or intact mucus membranes of a healthy person come into contact with objects such as soiled clothing, bed linen, or used needles contaminated with an Ebola patient's infectious fluids [1].

Case fatality rate

Ebola first appeared in 1976 in two simultaneous outbreaks, one in a village near the Ebola River in the Democratic Republic of the Congo, and the other in a remote area of Sudan [1].

Between September 1 and October 24, 1976, 318 cases of acute viral hemorrhagic fever occurred in northern Zaire (now known as Democratic Republic of the Congo). There were 280 deaths and only 38 serologically confirmed survivors. The index case was treated initially by injection of chloroquine for presumed malaria. Within a week, several others who had received injections were found to be suffering from Ebola, and all subsequent cases had either received injections at the hospital or had close contact with another case. The hospital was closed within 4 weeks of the outbreak, by which time 11 of its 17 staff had died.

It was not possible to identify a direct link between the two areas of outbreak. Although they are separated by about 4 days travel, it was thought likely that an infected person had made the journey.

Ebola virus antibodies were found in five people who were not ill and had not had contact with the infected villages or the hospital. This suggested that the virus may be endemic [3].

Clinical

The incubation period (time from infection to onset of symptoms) varies from 2 to 21 days. Patients are contagious only after the development of symptoms, i.e. people are not contagious during the incubation period.

The typical symptoms and signs are: sudden onset of fever, intense weakness, muscle pain, headache, and sore throat. These are followed by vomiting, diarrhea, rash, impaired kidney and liver function, and in some cases both external and internal bleeding.

The management of Ebola virus disease is by intense supportive care. Patients are frequently dehydrated and need intravenous fluids and electrolytes. There is no specific curative treatment.

Recommendations from the Commonwealth of Australia Department of Health for patients with symptoms compatible with Ebola, who have a history of travel or residence in affected areas in the 21 days prior to the onset of symptoms, or contact with a known probable or confirmed case in the 21 days before onset include:

Care for the patient in a single room and transmission-based precautions implemented (contact and droplet) using personal protective equipment (PPE) (including routine use of a surgical mask, disposable gown, gloves, and eye protection). P2 (N95) respirators should be used when aerosol-generating procedures are performed. Close attention to hand hygiene is important.

Blood and other samples should be collected for Ebola virus testing and other investigations, but because of the highly infectious nature of the fluids, routine testing should be minimized.

Primary diagnostic testing is detection of Ebola virus by PCR in serum, plasma, a throat swab or urine. Serology is also available. In Australia, testing is conducted in a Physical Containment level 4 laboratory (Victorian Infectious Diseases Reference Laboratory (VIDRL), Peter Doherty Institute, Victoria).

Necessity for institutional response

In view of the incubation period and availability of air travel, it is possible that travelers who have been in affected areas of West Africa, or have been in close contact with others who have been, will arrive in Australia and become ill. It is likely that these patients will be identified clinically, and in the event of their death, arrangements made which do not involve forensic services. However, a death could be referred to the Coroner/Victorian Institute of Forensic Medicine (VIFM) especially in cases of uncertainty about the diagnosis, or if a person from the affected region dies suddenly and unexpectedly.

Reference to this document can serve to advise about the handling of the deceased.

In case of an outbreak in Australia a new protocol would be developed based on the core principles of this protocol. In general, the new protocol would follow the approach of the International Committee of the Red Cross for management of dead bodies after disasters [4].

VIFM is responsible for contingency planning required for management of a multiple casualty event in its jurisdiction. This planning can be adapted to manage deaths due to a pandemic in which hospital mortuaries may be overwhelmed. VIFM are best equipped to manage multiple deaths. As a government facility, VIFM may also be requested to manage bodies when other mortuaries are not prepared to store or transport them. This situation could occur in cases of Ebola.

Coordinated response required: Forensic Pathology and Department of Health

In Victoria, Australia, suspected or known cases of Ebola virus require immediate notification to the Victorian Department of Health on 1300651160 and formal notification within 5 days. The director of VIFM will also notify the Chief Medical Officer and the State Coroner immediately. VIFM will work closely with the Department of Health in their response.

Management of a dead body with proven or suspected Ebola virus disease

Introduction—WHO GUIDELINES [5]

WHO has guidelines for the “Movement and burial of human remains,” as follows:

The handling of human remains should be kept to a minimum. The following recommendations should be adhered to in principle, but may need some adaptation to take account of cultural and religious concerns:

Remains should not be sprayed, washed or embalmed
Only trained personnel should handle remains during the outbreak

Personnel handling remains should wear PPE (gloves, gowns, apron, surgical masks, eye protection) and closed shoes

Protective equipment is not required for individuals driving or riding in a vehicle to collect human remains
Protective equipment should be put on at the site of collection of human remains and worn during the process of collection and placement in a body bag
PPE should be removed and placed in an infectious bag immediately after the remains have been placed in a body bag and transferred to a transport coffin. The infectious bag should also be placed in the coffin.

The coffin should be wrapped in sealed, leak proof material and should be cremated or buried promptly.

Response to a notification by police/health professional of a deceased suspected of having Ebola virus disease

The Coronial Admissions and Enquiries Office (CAE) has a role in monitoring reports of death and alerting the VIFM/Department of Health when a death has occurred in a person who has recently travelled to the African nations. If the deceased was reported to have flu like symptoms, the on-call pathologist is to be notified. Police are to be notified to secure the scene and await further advice.

The on-call pathologist, in consultation with Director VIFM will make the decision to either treat the deceased as “suspected EBOLA” or a normal case. The Department of Health should also be contacted on 1300651160 as they may be able to provide details whether the deceased is a known high risk.

Actions following decision that notified death is to be managed as possible/suspected Ebola

If the decision is made to treat the deceased as “suspected Ebola” the deceased is to remain in situ and the Victorian Police DVI/CBR unit will attend to provide advice and assist in the process. A VIFM forensic pathologist with appropriate PPE, including Tyvek suits, will attend the scene and collect a blood sample for testing at VIDRL.

Only the Department of Health can authorize EVD testing and they will make the initial contact with VIDRL. The forensic pathologist will notify the Department by calling 1300 651 160 to obtain authorization for EVD testing.

The sample is to be double bagged and transported by VIFM staff or DVI/CBR unit direct to VIDRL.

If the test is positive, a risk assessment will take place in conjunction with the forensic pathologist to determine the level of PPE required. If the scene is contaminated with large amounts of body fluids Level A fully encapsulated suits may be required to move the deceased. If there are no body fluids present, Level C may be used.

The police will treat the scene as a “hot zone.”

The trained police/fire brigade/forensic pathologist will attend the deceased and take overall photos. The deceased is transferred to a heavy duty leak-proof body bag.

This bag is then to be placed a second bag in the “Warm zone.” The outside of the bag is to be decontaminated with a disinfectant solution. An example of an effective disinfectant is sodium hypochlorite at 0.05 %, 500 ppm available chlorine (i.e. 1:100 dilution of household bleach at initial concentration of 5 %) [4].

The secured decontaminated body bags may then be transferred to VIFM mortuary by the normal funeral director arrangements with an escort.

Actions taken for the management of deceased suspected to have Ebola at VIFM

Component

Personal Protective Equipment (PPE)

Protocol

All persons required to remove/transport or examine deceased should wear at least:

- Double Gloves
- Tyvek suit or similar (fluid/biological hazard resistant or impermeable)
- Eye protection (goggles or face shield)
- P2 Facemask
- Disposable shoe covers.

Component

Admission of deceased

Protocol

Mortuary staff are to be alerted by the Coronial Admissions and Enquiries of suspected Ebola cases
 Prior to arrival the CT scanner room is to be prepared with a white disposable (fluid impermeable) sheet, all labels are to be ready and solutions of disinfectant available
 Staff are to wear four pairs of gloves
 Only two staff are to be present in the CT scanning room. One staff is to remain clean and act as a monitor and ensure safe procedures are followed
 Each staff member is to monitor and check each other to ensure correct PPE is being worn
 External surface of the bag is to be wiped with disinfectant
 Transfer the deceased using the body lift. Clean staff member to operate the buttons
 Once transfer is complete remove outermost pair of gloves
 The body bag is not to be opened
 An external label is placed on the bag
 A disposable infectious disease waste bag is to be placed on the trolley for all disposable gloves and PPE as they are removed.

Component

CT Scan

Protocol

The deceased is transferred to the CT room. The doors should open automatically. If buttons need to be pushed, clean towels are to be used and immediately disposed in infectious waste bag on trolley

A disposable white plastic sheet is to be placed on the CT Scan couch

Deceased is to be transferred to the couch via the body lift
 Two staff members are to leave the room and wait without touching any other surface until the CT scan is complete

A third staff member will operate the CT scanner from a separate room

On completion of the CT scan the deceased is transferred back to the original trolley. The disposable white sheet to be placed in the infectious bag.

Component

Storage of deceased

Protocol

Deceased should be stored in isolated (homicide) refrigerator
 Once the deceased is placed in the fridge, the two staff members remove all PPE in a safe manner and place in the disposable infectious bag which remains with the deceased
 Hand hygiene procedures should take place
 Only authorized personnel are to enter the fridge
 A log of all persons accessing the deceased should be maintained.

Component

Cleaning of the CT Scanner room

Protocol

The same staff are to don full PPE and clean the couch and the straps of the body lift with disinfectant solution
 PPE is to be removed safely, placed in infectious waste bags and stored with the deceased.

Component

Examination of deceased

Protocol

Examinations should take place in the special autopsy suite
 Minimal staff should be present
 All examinations should take place with the body remaining in the body bag.

Component

Examination equipment

Protocol

Limit the use of needles and other sharps as much as possible
All needles and sharps should be handled with extreme care and disposed of in puncture-proof, sealed containers. This container should remain with the deceased.

Component

Sampling

Protocol

Specimen to obtain: blood by precordial stab
A minimum volume of 4 mL whole blood preserved with EDTA, clot activator, sodium polyanethol sulfonate (SPS), or citrate in *plastic* collection tubes can be submitted.

Component

Post examination cleaning

Protocol

Diligent environmental cleaning and disinfection and safe handling of potentially contaminated materials is paramount, as blood, sweat, vomit, feces, and other body secretions represent potentially infectious materials
Staff performing environmental cleaning and disinfection should wear full PPE (described above)
The external surface of the body bag is to be wiped down using hypochlorite solution, prior to returning to the refrigerator
PPE is to be removed safely and placed in the infectious disease waste bag and stored with the deceased.

Actions following confirmation deceased has tested positive to Ebola

The nominated funeral director is to be contacted as soon as possible to arrange burial.

Mortuary staff are to don full PPE and prepare the body bag for transfer to coffin.

All waste is to be enclosed within the body bag.

The funeral directors are to deliver a coffin and mortuary staff will transfer the deceased directly into the coffin.

Once transfer is complete, the staff are to clean lifting equipment and wipe down any external surface of the coffin that came in contact with the body bag.

Staff are to remove PPE safely.

PPE to be placed in an infectious bag in the coffin.

Coffin is to be sealed and transferred for burial.

Management of exigent circumstances such as an outbreak of Ebola Virus Disease

It is anticipated that, once an outbreak has been established, the majority of cases will not require medicolegal death investigation. However, it may be necessary to store bodies at VIFM. The protocol described above would then be followed.

Unusual circumstances would include the homicide of an Ebola patient. The necessity for, and extent of, the post-mortem examination would be determined on a case-by-case basis in consultation with the Crown Prosecution Service and/or Coroner.

Communication with staff

VIFM will undertake a training session for staff with information about Ebola and protective measures.

Communication with families and external stakeholders

VIFM will manage all communications with families and stakeholders according to standard procedures.

Suspected injury or exposure of staff member

Staff with percutaneous or mucocutaneous exposures to blood, body fluids, secretions, or excretions from a deceased with suspected Ebola, or asymptomatic staff members who have been exposed to a deceased with Ebola, would be immediately referred for appropriate medical care and monitoring, in accordance with jurisdictional health policies.

Key Points

1. Ebola Virus Disease (EVD) may present sporadically in developed countries, and protocols should be developed which enable departments of forensic pathology to manage suspected or diagnosed cases

presenting in the community or at public mortuaries safely and efficiently.

2. Suspected or diagnosed cases of EVD in deceased individuals require a collaborative and cooperative approach to diagnosis and body management from public health departments, diagnostic laboratories, emergency service providers, forensic pathology departments, and funeral directors.
3. This protocol is the result of a collaboration between departments of forensic pathology in Australia and Canada, and will serve as a model for future jointly developed protocols, particularly with respect to novel or re-emerging viral pandemics.
4. This protocol may be modified for use according to local infrastructure and resource availability.

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