

## Disaster preparedness and evacuation plan (DPEP) in haemodialysis units: patients' emergency self-disconnection through "Clamp and Cut" procedure.

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### Learning Objectives

1. To provide basic guidelines for possible disasters in haemodialysis units.
2. To learn how to manage and provide best possible care within the scope of different emergency situations.
3. To learn how to be prepared for various types of disasters and reduce injury and damage.
4. To gain knowledge on haemodialysis patients' emergency self-disconnection through the "Clamp and Cut" technique.
5. To understand when and how patients can proceed to self-disconnect from haemodialysis machines in an emergency.

**Key Words:** disaster preparedness, haemodialysis unit, evacuation plan, patient training, emergency self-disconnection, clamp and cut procedure.

### Introduction

Hospital emergency preparedness and evacuation plans for both staff and patients are a major and important part of disaster management strategy within the healthcare setting.<sup>1</sup> In the last decade the impact of disasters on the provision of dialysis services has received increased attention and has highlighted the importance of developing and preparing structured processes within dialysis units.<sup>2,3</sup> Disasters can be caused by both natural phenomena, such as earthquake, tsunami, typhoon, storms and flooding or by human induced events, such as terrorist acts, chemical, nuclear, and explosive hazards.<sup>4</sup>

Disaster events interrupt provision of dialysis with adverse effects in patients. These may include missed sessions, increased hospitalizations and exacerbations of comorbidities, such as hypertension, diabetic complications and cardiovascular diseases.<sup>5,6,7</sup> Additionally, patients on haemodialysis (HD) may suffer from post-traumatic disorder following the need to be relocated, experiencing prolonged periods of displacement from family, and lacking social and emotional support.<sup>8</sup>

Appropriate preparation of HD units is an important part of disaster management within the nephrology healthcare setting.<sup>9</sup> Without suitable emergency planning, units and staff can

become overwhelmed in attempting to provide care during a critical event.<sup>10</sup>

In this article recommendations for the HD unit, including staff and patient preparations for different types of disasters are provided.

### Disaster preparation program strategy for HD facilities

The main strategies for disaster preparation vary according to the type of disaster, geographical area, possibility to forecast the disaster, possible damages that can occur according to the regional environmental scan and the political and social situation in each region.

Prior planning for disaster-related events helps to mitigate their impacts and significantly improves patient outcomes.<sup>3,11</sup> Guidance for the development of comprehensive emergency preparedness programmes are available.<sup>12,13</sup> In general, a successful preparation includes the following steps:

- a. Arranging collaboration programmes with nearby dialysis facilities; including possible transportation plans or additional locations to accept emergency dialysis patients or patients from other facilities.
- b. Contacting local emergency medical services

(EMS) in order to include the HD facility into the medical emergency plans of the area.

- c. Forming a disaster reaction team. This team should consist of the facility administrator, head nurse, chief technician, social worker, dietitian, medical director, and an administrative assistant. Regular team meetings should be scheduled in order to motivate and audit team preparation.
- d. Preparing and evaluating infrastructure and technical readiness of the facility on a regular basis: including electric generator, water tank with appropriate capacity and suitable storage amounts of emergency medical equipment in the facility.
- e. Developing and updating on a regular basis appropriate facility plans that focus on the types of disasters likely to occur in the area. All staff should be fully trained according to the plan and be aware of their responsibilities during a disaster. Regular practice drills should be performed and evaluated.
- f. Educating patients about disaster preparedness. This should include providing training for specific scenarios in emergencies and information on:
  - HD patients' training on emergency self-disconnection from HD through "Clamp and Cut" procedure
  - Setting a patient and staff meeting point outside the hospital building
  - Organization and regular training drills for patients and staff

### **Types of emergency situations and possible implications on HD facility**

The first step for disaster preparation should include facility structure assessment according to the potential types of disasters in the region. Preparation of appropriate treatment shelters with water purification systems and appropriate infrastructure may be required, e.g., building with fire-resistant materials or replacing windows with shatter-resistant glass. Some preparation may have financial implications that should be taken into consideration at the initial step of the preparation process.<sup>14</sup> In the event such as an earthquake, all HD staff should be well prepared and pre-identify likely sheltered spaces like under desks, tables and spots that are away from glass surfaces or exterior walls. Special precautions should be taken by the HD staff care team to place heavy and fragile objects at a low level, secure bookshelves, oxygen and lighting consoles and check ceiling panels. Additionally, all HD machines, chairs and carts with medical equipment should be immobilized by always putting the brakes on, so as to avoid possible injury from their displacement caused by the earthquake.<sup>14,15,16</sup>

### **HD before a predictable event**

If the HD centre is in the middle of the disaster area the unit may be destroyed or there may be disruption of utilities, such as water and electricity. Scheduling HD treatment before a predicted disaster can help avoid or reduce complications related to missing HD sessions after the event.<sup>17</sup> Preparation

of additional emergency HD stations or mobile reverse osmosis machines will increase capability of performing HD for as many patients as possible before the disaster.<sup>18</sup> When there is a lack of time or reserve capacity for HD sessions, the duration of the HD sessions can be reduced to allow more patients to receive dialysis treatment before the event.

### **Power failure during event**

Power failures often follow natural disasters. All HD centres should have backup generators to ensure continuity of patients care during electric power blackouts. Even centres with backup generators may have problems operating these units. Regular maintenance of generators and staff education regarding the capacity and backup of generators is essential.<sup>19,20</sup> Different HD machines operate differently in times of power failure and while on battery energy supply mode - some have alarms or treatment modalities that are not available during emergency power supply. Staff should be aware of these restrictions and know how to adjust treatment accordingly.<sup>14,17</sup>

### **Water supply during event**

HD is not possible without appropriate water supply. Two major problems can be expected during a disaster event: disruption to the water supply and problems with water quality.<sup>21</sup>

Water tanks with appropriate capacity for each unit should be placed in an area with high physical protection and an emergency power supply system. The amount of water should be sufficient for at least one HD session for all patients in the unit. The water quality should be maintained and regular water tests should be done from the tank.<sup>3,21</sup>

After the disaster, immediate contact with the technical engineer responsible for the water system in the unit is crucial. Close monitoring of the conductivity and product water will be needed to detect any decrease in quality. Weekly microbial assessment of the water quality during the disaster time is recommended. Municipal water suppliers may choose to add extra chlorine to the supply in order to bring water back into compliance with the acceptable standards for drinking water, which may result in chlorine/chloramine breakthrough. Nursing staff at the HD unit should be familiar with the facility's testing procedures and guidelines for patient care in case of blood exposure to the high levels of chlorine/chloramine. Nursing staff should also be aware of the possible haemolysis signs and symptoms and the required interventions such as to stop the dialysis immediately and not to return blood to the patient. The unit may be required to increase frequency of chlorine monitoring from each patient shift to every hour or continuous online monitoring.<sup>17,18</sup> Charcoal filters and connection hubs should be available for implementation into the pre-cleaning and filtering of HD water system.

### **Access to treatments post-disaster**

Even if damage to the HD facility is limited, staff and patients may face disruption of transportation services and lack

of physical access to the HD unit after the disaster. Methods of transportation should be defined in advance according to possible scenarios and should anticipate road damage and blockages. Boats, helicopters or special military cars are possible alternatives.<sup>21</sup>

Determination of workload must consider the possibilities of staff shortages and of more or sicker patients. Patients may suffer from anxiety, encounter a lack of medications, experience new illnesses or may be in dire need of HD. Additionally, new patients may transfer from units that are unable to provide treatment. The facility should be available to provide emergency HD and refill prescriptions, and additional staff may need to be identified.<sup>14</sup> Additional staff may be recruited from retired staff willing to help, or by utilizing non-HD staff for assistance in monitoring patients during treatments.

In cases of extensive damage to the local infrastructure resulting in the unit being unusable, the HD unit should have in advance a list of other units in the area, that includes capacity and number of patients that can be taken. Detailed description of the transfer plan and alternative location for the HD treatments, with close communication and network between HD units and methods of sharing patient data should be decided in advance.<sup>2,10</sup> Each unit has to ensure access to patient information in order to provide the treatment plan to the host unit. Many HD units have computerized medical records and patient records can be accessed from any location. Facilities should maintain off-site copies of all required information for HD treatment, in case of situations when access to electronic files is not possible or for units without electronic medical records systems.<sup>14</sup>

### **An emergency and HD unit disaster preparedness evacuation plan**

The delivery of HD treatment can be disrupted by natural and weather-related phenomena or human induced events.<sup>13,10</sup> Due to the features of HD being a therapy which involves extracorporeal circulation with all the complications and risks this may comprise, it is recommended that an emergency evacuation and preparedness plan should be developed and maintained in every HD unit including patients training on the "Clamp and Cut" (or Clamp & Disconnect) emergency self-disconnection procedure.<sup>14,15,16,22</sup> An HD unit emergency evacuation plan for disaster is only possible when patients are disconnected and released from the HD machines.

### **Why patients should be trained on the "Clamp and Cut" emergency self-disconnection procedure**

Patients need to be appropriately trained on how to safely self-release themselves from HD, if in an emergency situation evacuation of the HD unit and the hospital building is instructed. Catastrophic events like the phenomenon of an earthquake which is particularly characterized by its unpredictable nature or other weather phenomena with limited forecasting or a terrorist attack, all may cause massive material damage with serious injuries and loss of human lives. Therefore, if such an event occurs during an HD session and the hospital building has to

be evacuated, HD patients who are trained to carry out emergency self-disconnection from HD through the "Clamp and Cut" technique can safely self-release themselves from HD. Protection of the vascular access during an emergency situation while evacuating the HD unit is of paramount importance. Patients' knowledge on how to act can help prevent injury or damage of the vascular access.<sup>14,16,23</sup>

Simultaneous disconnection of all HD patients is impossible, so if trained patients can self-disconnect from HD, then the staff will be available to disconnect the remaining patients who are unable to do so. Another parameter to be taken into consideration in catastrophic events is that HD staff might be injured and not able to assist. An emergency patients' HD self-release training is important as it equips HD patients with the knowledge and confidence to take control in such a situation; this can create an atmosphere in the unit which promotes calmness and reduces anxiety among patients.

### **Patients' training and criteria for emergency self-disconnection procedure**

Ideally, all patients should be considered for training by HD unit staff on how to perform emergency self-disconnection from the machine through the "Clamp and Cut" technique in order to safely evacuate from the HD unit. However, not all patients can qualify for training on emergency HD session termination as not all patients are capable to achieve emergency HD session termination through this technique. A careful enrolment for training of HD patients should be employed following evaluation based on established criteria; these may include the patients' level of perception and understanding of a critical situation and the patients' hand co-ordination. Mentally impaired patients will be assisted to be disconnected and therefore should not be included for training. Moreover, according to guidelines, emergency patient 'self-disconnection procedure training mainly refers to patients whose vascular access type, is either an arteriovenous fistula (AVF) or arteriovenous graft (AVG). Patients with central venous catheters (CVC), will be assisted in the release from HD.<sup>22</sup> It is of paramount importance to clearly warn patients that they can proceed to "Clamp and Cut" procedure only in extreme emergency situations and following HD unit staff instructions.<sup>15,24</sup> The HD facility should establish a policy to identify those patients who will need assistance in disconnection and evacuation during an emergency. Medical records should include evidence of training in emergency evacuation and preparedness. Patients should be able to verbalize how they would self-release from HD and evacuate the facility, or if unable, how they would be evacuated.<sup>23</sup>

### **The "Clamp and Cut" technique**

In order to perform "Clamp and Cut" technique, patients should have access to the HD machine preferably with a rotating screen, which should be within reach and facing the patient. Most importantly, patients need to have access to the emergency kit which should contain a cutting tool (cutter)/scissors, tape and clamps, and should be kept always within reach while connected to the HD machine. Each patient should always keep his/her emergency kit with him/her at all times

during the session. In the event of an emergency during HD session, patients must be reminded to stay calm and wait for instructions from the HD staff.<sup>14,15,22</sup>

It should be emphasized that the patient's self-disconnection method from HD machine should only be used during emergency situations. The patients are trained to self-disconnect in 3 steps:

Step 1
<p style="text-align: center;"><b>Stop the HD machine blood pump.</b></p> <p>The patient gets trained with his/her free hand to operate the screen of the HD machine and to press the <b>Stop button to terminate the HD session</b></p>
Step 2
<p style="text-align: center;"><b>Clamp the clips on all 4 lines: 2 vascular access lines &amp; 2 bloodlines</b></p>
Step 3
<p style="text-align: center;"><b>Cut between the closed clips</b></p>

Patients should be very cautious **about never to cut the access needle lines between the clamps and the access.** In the event of such a mistake, the patient may die from excessive bleeding.<sup>25</sup>



Figure 1. "Clamp and Cut" technique performed by a patient during drills at Dialysis unit, General Hospital of Kefalonia, Greece

If the patient's vascular access is a CVC, the staff will perform HD session disconnection and termination. For safety reasons, a patient with a CVC must never try to self-disconnect by performing the "Clamp and Cut" procedure, as there is a great risk of life-threatening errors causing excessive bleeding or severe air embolism due to open hubs and irreparable damage to the CVC.<sup>22</sup>

### The emergency HD Unit First-Aid Kit

It is important that a **First-Aid Kit** is prepared and kept outside the main hospital building (e.g., hospital main entrance) or at the emergency exit of the HD unit. With the First Aid Kit staff can provide care to the vascular access following the evacuation in order to enable removal of AVF needles and flushing and locking of CVCs.<sup>26</sup>

The First-Aid Kit should contain the following:

- Sterile gauzes, wound dressings and tapes
- Connection sets, syringes, CVCs solution locks
- Medication, antiseptics, NaCl 0.9 % 1000/500ml bags



### Vascular Access Care following evacuation

- ✓ **Patients should wait for instructions** after disconnection and evacuation of HD unit to a designated safe area.
- ✓ **HD needles should not be removed** until individual patient's condition is evaluated or patients are assured that they are in a safe area and out of immediate danger.
- ✓ Special consideration is taken for **CVCs handling and care: CVCs should be flushed and solution lock should be administered.**<sup>22</sup>

**Attention: Under no circumstances** should any **healthcare personnel unfamiliar** with the patients' HD status, **inject** any solution or medication into the **vascular access.**<sup>22</sup>

### Drills at HD unit-preparedness for disaster situation

The HD staff and the patients should be prepared for the emergency evacuation plan. Disaster drills should be scheduled to be performed quarterly in accordance with the evacuation plan so to practise emergency self-disconnection "Clamp and Cut" technique and termination of the HD session.<sup>14,22,15,23</sup> For demonstration purposes, the procedure may be performed when patients have just had their blood returned, but are not yet disconnected. The procedure should be simulated with the emergency kit available on the patients' machine at the chair/bed side. Regular practice can help to instil awareness, calmness and preparedness in the minds of all. Also, a designated safe area following evacuation should be pre-established and all staff and patients should be informed of this. The preparation of a First-Aid Kit (to be used following the event) is also recommended as well as the emergency kit that should be within reach of the patient while on HD.<sup>27</sup>

## The role of the HD health care team during and after the catastrophic event

Disasters occur quickly and without warning, so being prepared to deal with such situations can minimize their impact. Therefore, the coordination of the emergency HD disaster plan is among the crucial roles of the HD care team to decrease injuries and losses. First aid care is provided in case of injuries in a prompt and effective way to reduce panic. Patients receive psychological support from the HD care team to remain calm, to cope with fear, anxiety and panic during the event. It is of high priority in disaster situations for the HD care team to keep calm themselves and try to promote a positive attitude to other colleagues as well as to the patients.<sup>28,3,29</sup>

## Benefits of the emergency self-disconnection from HD

Taking into consideration that HD involves extracorporeal circulation, it is a stressful procedure itself with its potential complications. Patients would feel more confident and less anxious knowing that they have learnt the technique to self-release themselves safely from the HD machine in an emergency situation. Patient training on the "Clamp and Cut" technique can also prevent them from the dangerous act of pulling out the HD needles when in a panic.<sup>22</sup> For example, this training is particularly useful in areas prone to earthquakes, this stops patients from feeling helpless due to the unpredictable nature of earthquakes. It is worth to note that during a period of great seismicity which may last for 2-6 months following a massive earthquake, during a 4-hour HD session patients may experience at least 30 shakes which can provoke them to feel being at high risk. Similarly, in emergency situations caused by fire, typhoons/storms or terrorist attacks.

Thus, the implementation of the hospital disaster preparedness and evacuation plan to a HD facility is considered of great importance for all types of disasters.<sup>27,3</sup>

## Conclusion

Disasters can significantly increase morbidity and mortality in the chronic kidney disease population. An appropriate disaster preparation programme for HD units, on organizational, patient and staff levels, can decrease the confusion and chaos that characterize the post-disaster period.<sup>29</sup>

Considering that HD is an essential life-sustaining treatment, all units, and not just those in disaster-prone countries should be prepared for various disaster scenarios. Preparations for the management of patients in the dialysis setting during possible disasters should begin a long time ahead and include a well-prepared action plan. The preparation processes should include all aspects of nephrology care and take into consideration all possible scenarios and all technical, health and environmental complications. An overall goal of the preparation plan is to ensure an effective disaster response within the HD unit and provide the best possible care to the patients.

A HD Unit disaster evacuation plan can only be possible provided all HD patients are disconnected and released from

the HD machines. Therefore, it is recommended to develop, implement and maintain an emergency preparedness and evacuation plan including patients training on the "Clamp and Cut" a self-disconnection procedure for all emergency situations.

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