

## What to do in case of Cardioplegia Delivery System Failures

If the delivery system fails when delivering cardioplegic solution, depending on how you respond, adequate myocardial protection may not be obtained, and myocardial injury may occur. Following are some points to note and countermeasures when the cardioplegia delivery system fails. Please refer to them to ensure safe and reliable delivering of cardioplegic solution. However, since each facility has different cardioplegia methods and delivery systems, there is a wide variety of troubleshooting strategies, so please use this Safety Information to develop a plan of action for each facility.



### **【Points to note in the initial action upon trouble】**

- 1) If a problem occurs with the delivery system and cannot be restored, inform the surgeon and anesthesiologist, and use an alternative delivery method, such as manual operation.
- 2) If delivering is difficult, it is necessary to check the allowable time before cardioplegia delivery.
- 3) Even when delivering by alternative methods, the prescribed volume of cardioplegic solution must be delivered, paying attention to the perfusion or the distal pressure.
- 4) In case of a system that delivers blood cardioplegia with two pumps or a chamber-type delivery system, it would be difficult to deliver a precise mixing ratio by manual operation, so it is necessary to consider alternative measures in advance.
- 5) The composition of cardioplegic solution upon trouble should be thoroughly discussed in advance with the physicians.

### **Handling**

#### **① If only the display is disabled:**

- The operation of the delivery pump should be checked visually and by perfusion or distal pressure.
- If the pump is operating, the delivery volume should be determined by the delivery time.
- Attempt to add monitors and reboot the device.
- If the display does not resume, please refer to the next section “**If the entire system is disabled**” below.

## ② **If the entire system is disabled:**

- Check the power supply status.
- If there is a spare system available, replace the system.
- If a spare system is not available and using only crystalloid cardioplegia, switch to a method using gravity and pressurization bag for its delivery. If blood cardioplegia is used, store a certain amount of blood from the heart-lung machine in an infusion bag, add the prescribed crystalloid solution and deliver the mixed solution using a separate pump.
- In case of a chamber type delivery system, check the manual provided by the manufacturer and deliver with the dedicated manual device. (If blood cardioplegia is used, a pre-mixed cardioplegia solution must be available for delivery.)
- If the system cannot be restored and manual delivery is performed, careful attention is needed as the bubble detector or level sensor is not available.

## **Countermeasures**

- Prepare a blood bag to store a certain amount of blood from the heart-lung machine and mix it with the prescribed amount of crystalloid to deliver cardioplegia solution. A separate circuit is required if delivery is to be done by another pump, so an emergency circuit should always be available.
- Be sure to know in advance the flow rate per revolution for manual operation in the roller pump or the chamber type system. (Flow rate is especially important for Calafiore cardioplegia and microplegia.)
- Since blood cardioplegic solution has electrolytes corrected to the appropriate ratio with blood, its composition should be considered in advance, assuming the case of switching to delivery of crystalloid solution only.
- If the system also incorporates a cooling system, there is a possibility of a cooling shutdown, so a method to cool the crystalloid solution should also be considered.
- If the perfusion or distal pressure is displayed on the cardioplegia delivery system, a spare monitor should be prepared in case of failure.
- Simulation training for troubleshooting should be conducted on a regular basis to respond promptly to problems with cardioplegia delivery system.