



## Review Article

# Management of Multi-Organ Failure: Nursing Role

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### Abstract

Multi-Organ Failure syndrome (MOF) is a reason for admission to intensive care or can occur during hospitalization. It is characterized by associated failures of several organs (heart, lungs, liver, kidneys, brain). The prognosis is all the more gloomy as the number of affected organs is high. It is due to an alteration of the microcirculation responsible for an acute and lasting cellular hypoperfusion, encountered during an aggression (trauma, pancreatitis, burns, states of cardiogenic or hypovolemic septic shock) requiring substitutive treatments, artificial ventilation, renal replacement therapy, hemodynamic support and appropriate nutritional intake.

**Keywords:** Multi-organ failure (MOF); Hemodynamic; Ventilation; Extra-corporeal support; Nursing care

### Objectives of Nursing Care

The therapeutic nursing objective is to anticipate clinical changes, notify the resuscitator as soon as possible, in order to limit the aggravation of failures by the rapid introduction of specific therapies [1]. This patient care involves close collaboration between the doctor and the paramedical team. Clinical monitoring and monitoring are the main axes, associated with the monitoring of specific treatments.

**First time surveillance:** The management of patients with MOF requires increased nursing supervision, requiring theoretical and technical knowledge.

**Cardio-Circulatory Failure:** Cardiocirculatory failure is characterized by persistent arterial hypotension despite adequate vascular filling. The objective is to assess the impact of this failure on perfusion and therefore on tissue oxygenation.

**Clinical monitoring:** Involves mottling (signs of impaired peripheral circulation), cyanosis, pinkish foaming bronchial secretions, and swollen jugular joints (signs of heart failure). Biological monitoring is carried out on medical prescription by a dosage of lactates (signs of cellular suffering), an arterial gas, a

blood count, a blood ionogram, a liver and kidney test.

### Non-Invasive Monitoring Includes

One cardioscope per patient connected to a central monitoring unit: heart rate monitoring and alarm settings allow rapid identification of any rhythmic change, type of atrial fibrillation, extrasystoles, tachycardia or bradycardia, justifying medical intervention to initiate appropriate therapy; Taking blood pressure in the cuff every 15 minutes with recording of systolic, diastolic and mean blood pressure. The alarms are set according to the therapeutic objectives to be achieved. The parameters provided by these different techniques are recorded on a monitoring sheet or in a computerized memory of patient parameters.

### Invasive Monitoring Includes

Sterile placement of catheters by the doctor according to department protocols. The nurse prepares the necessary material and serves the operator sterilely. Changes of tubing and dressings are redone in accordance with the protocol of the service. There are several catheter devices: Arterial catheterization is an invasive device allowing the continuous monitoring of blood pressure, the realization of iterative blood samples, the monitoring of the pulsed pressure delta (Delta PP), measurement of the systolic-diastolic differential variation during a respiratory cycle in the patient who is intubated, ventilated, adapted to the ventilator and in sinus

rhythm. It informs us about the need for a filling (>13% = signs of hypovolaemia). The catheter is placed in the radial or femoral artery. This vascular access must be clearly identified in order to avoid an intra-arterial injection, placement of a Central Venous line (CVA) consists of preferably placing a multilumen catheter in the subclavian, internal jugular, femoral or axillary veins. Each channel has a dedicated function (exclusive administration of vasoactive drugs by auto-pulsed syringe, sedation and curarization if necessary, hydration solutions, vascular filling, parenteral nutrition, possibly central venous pressure measurement system. A peripheral channel can be kept for a possible transfusion of blood products or derivatives.

The Central Venous O<sub>2</sub> Saturation Catheter (SCVO<sub>2</sub>) is a central venous access equipped with an infrared probe, connected to a specific monitor, allowing the continuous calculation of the oxygen saturation coefficient of the venous blood, giving a reflection of the oxygen consumption, itself a reflection of the optimization of the cardiac flow. The SCVO<sub>2</sub> represents the fraction of oxygen remaining bound to hemoglobin, after the cellular extraction of oxygen, measured.

Every hour, the nurse notes on the monitoring sheet the number indicated on the monitor and notifies the doctor if the value differs from the fixed objective, catheterization of the right cavities by Swan Ganz probe [2-5] consists of introducing the catheter most often through the internal jugular vein. It makes it possible to specify the mechanism of the hemodynamic failure, the monitoring and the adjustment of the therapies instituted by the analysis of the measured parameters (pressure of the pulmonary artery which reflects the right heart activity), the pressure of the right auricle which gives an indication of the venous return, pulmonary arterial pressure of occlusion (which reflects the filling pressure of the left ventricle), cardiac output allowing the calculation of the systemic vascular resistances, reflection of the resistance of the vessels to cardiac emptying, the Cardiac Index (CI). The nurse must ensure the correct positioning of the Swan Ganz (landmark), note Pulmonary Artery Pressure (PAP) and right ear pressure (RAP), cardiac output (CF) values and give the alert in case of modification.

#### **There are other less invasive techniques which limit the risk of nosocomial infections**

- Trans-thoracic ultrasound, which studies the kinetics of the heart, provides information on a possible cause of shock (cardiopathy, valvulopathy) and assesses blood volume;
- Esophageal Doppler, which uses a Doppler probe placed in front of the descending thoracic aorta to calculate cardiac output and systemic vascular resistance by indirect measurement. It is a less reliable technique but easy to perform by a cardiologist.

- The association ScvO<sub>2</sub>, bloody blood pressure (pulse pressure PP), systolic blood pressure (SBP), mean blood pressure (MAP), diastolic blood pressure (DAP).

#### **Respiratory Failure**

MOF is associated with respiratory distress requiring use of intubation and mechanical ventilation. The goal is to improve oxygenation, in order to ensure satisfactory haemostasis, to reduce the work of breathing, metabolic needs and to protect the respiratory tract from the risk of inhalation. Clinical monitoring is based on skin color, peripheral oxygen saturation (saturometer), capnography, respiratory rate, adaptation of the patient to the artificial respirator, symmetry of the chest expansion (reflecting the correct positioning of the endotracheal tube and effective ventilation), heart rate and blood pressure. Mechanical monitoring of the ventilated intubated patient concerns the verification of ventilation parameters, the positioning of the intubation tube, noting the fixing mark. Performing a chest x-ray, usually daily, makes it possible to check the correct positioning of the endotracheal tube three centimeters above the carina. A downward slide may cause selective ventilation and then atelectasis of the unventilated lung. The inflation pressure of the sealing bag will be checked three times a day and in the event of audible leaks, by connection to a pressure manometer to maintain effective ventilation.

Ventilator monitoring includes checking the setting of exhaled volume alarms, insufflation pressures to avoid barotrauma, circuit tightness, antibacterial filter, tube permeability (quantity and appearance of secretions by sterile endotracheal suction with instillation of isotonic saline, if necessary). An obstruction of the probe is manifested by an increase in insufflation pressures most often accompanied by a lack of adaptation of the patient to the respirator, even in the sedated patient. This monitoring will be all the more important if the patient is paralyzed.

Biological monitoring consists of carrying out gasometry and lactate assays on medical prescription. It is necessary to monitor the appearance of complications, such as variations in ventilatory parameters or sudden and lasting desaturation. Acute Respiratory Distress Syndrome (ARDS) may be associated with MOF, which may justify the use of nitric oxide, ventral decubitus ventilation and more recently the use of a Membrane Oxygenator (ECMO), techniques that increase the workload. nurse and justifying a high number of caregivers per patient. Bacteriological monitoring consists of bronchial samples (aspiration, protected bacteriological catheter), carried out by the nurse (search for multi-resistant bacteria).

#### **Kidney Failure**

Renal failure is defined by a diuresis less than 0.5 mL/kg/h. The nurse should place a catheter in remains according to the

protocol of the service, monitor its permeability, hourly diuresis (a decrease is the first sign of peripheral hypoperfusion) and the appearance of urine, make the daily assessment of the entries/exits, carry out a daily weighing, monitor the appearance of oedemas, administer diuretics on prescription. Biological monitoring of the urinary ionogram, blood urea and serum creatinine is daily. Renal hypoperfusion leads to acute renal failure with water and sodium retention, ionic (hyperkalaemia) and metabolic disorders. After hemodynamic optimization, the non-resumption of diuresis requires the use of extrarenal purification after placement of a dual current catheter in a central vein, internal jugular, axillary, femoral or subclavian. The nurse prepares the dialysis generator, applies the medical prescriptions relating to flow rates, anticoagulation and the composition of the baths, connects the patient to the dialysis catheter, manages the alarms, monitors the catheter (kinking, bleeding, signs sites of infection, thrombosis), performs the prescribed biological examinations (blood formula, ionogram, coagulation, gasometry), monitors capillary glycaemia (risks of hypoglycaemia) and temperature (risks of hypothermia due to the extracorporeal circulation), as well as that the hemodynamic impact of dialysis, which is not always tolerated (Arterial Pressure, Heart frequency, CVP, marbling). In the majority cases, anuria justifies the removal of the bladder catheter, a device implanted in an empty bladder being an infectious portal of entry.

### **Neurological Deficiency**

Neurological failure may be of metabolic origin, damage to the central nervous system (infection, trauma, vascular) or toxic. Monitoring is based on obtaining responses to simple commands, the reactivity of the pupils, the appearance abnormal movements (realization of an electroencephalogram, if necessary), the disadjustment of the patient to the ventilator, the detection of signs of awakening (spontaneous movements, effort to cough, agitation, hypertension, tachycardia, signs of pain). In the event of severe cranial trauma with brain oedema, Glasgow score lower than 9, it will be necessary to monitor the intracranial pressure (ICP) by the implantation of a trans-cranial fiber optic catheter and a retrograde jugular venous catheter to control the venous oxygen saturation in the cerebral territory, which must remain  $\geq 70\%$ , witness to good cerebral perfusion. Cerebral perfusion pressure (CPP) is equal to mean arterial pressure (MAP) minus intracranial pressure (ICP) ( $CPP = MAP - ICP$ ). The ICP must remain less than 15 mm Hg.

### **Hepatic Failure**

Hepatic failure is the consequence of a destruction of hepatocytes and is characterized by cytolysis, a decrease in coagulation factors and hypoalbuminemia. The majority of MOFs cause coagulation disorders, fibrinolysis and Disseminated Intravascular Coagulation (DIC). It is necessary to establish a clinical and biological monitoring bearing on the appearance of

externalized bleeding or not, of a cutaneo-mucous jaundice, of a purpura or hematomas and the monitoring of the markers of cytolysis (transaminases, bilirubin) and hemostasis (fibrinogen, coagulation factors, platelets, prothrombin, hemoglobin). A blood transfusion may be necessary, it is necessary to ensure the presence and validity of the blood group card upon admission to intensive care.

### **Digestive and Nutritional Failure**

Digestive and nutritional failure is due to disturbances hemodynamics of splanchnic blood flow, responsible for ischemia of the mucosa and ulcerations which may be complicated by hemorrhage. Mesenteric ischemia promotes bacterial translocation, a source of extremely serious infections.

All intubated patients are carriers of a double lumen gastric tube. Correct positioning is checked by epigastric auscultation and radiography. We will pay attention particular to the risk of pressure ulcers on the sides of the nose when attaching the probe. Monitoring is based on assessment of gastric emptying by the residues or the volume if the aspiration is continuous, the aspect gastric fluid (fecaloid). Tube feeding should be preferred, as it constitutes a natural barrier to gastric ulceration. Its tolerance is assessed by the absence of vomiting, transit monitoring (quantity, frequency and appearance of stools). The use of proton pump inhibitors is part of digestive protection acts. The realization of capillary glycemia with insulin protocol, if necessary is carried out every four hours, and the blood ionogram is usually checked every day.

### **Prevention of Risks and Complications**

#### **Catheter Risks**

The risks associated with catheters are related to the installation itself (pneumothorax, vascular lesions) or remotely are secondary complications, hemorrhage, gas embolism (in the event of accidental uprooting or poor connection of tubing), thrombosis or infection.

#### **Risk of Thrombo-Embolism and Trophic Disorders**

Prolonged bed rest the use of catecholamines, impairment tissue perfusion, immobility related to sedation and curarization, the general condition of the patient and the catheters are sources appearance of thromboembolic and trophic disorders. the nurse is responsible for the administration and monitoring of anticoagulants and venous contention. In addition, the MOF requires nursing care (toilet, care eyes...) and multi-daily pressure ulcer prevention, in collaboration between nurses, nursing auxiliaries and physiotherapists, with monitoring of pressure points, repeated massages and use of forced-air mattresses [6]. Postural changes in these patients can be hemodynamically or respiratory deleterious. The presence of multiple catheters and probes increases the risk

of tearing or accidental disconnection. The use of catecholamines leads to peripheral vasoconstriction, which increases the risk of pressure sores and necrosis of the extremities which may justify amputation. It is necessary to be even more vigilant in the curarized patient (abolition of muscle tone with risk of abnormal joint mobilization of the patient “rag doll”, absence of spontaneous ventilation in the event of accidental disconnection of the respirator). Monitoring and adaptation of curarization are carried out by curarimetry.

## Conclusion

Supporting a MOF is complex. It increases by considerable way the workload of caregivers by the technologies heavy penalties implemented and increased and close monitoring that she imposes. Any new nurse starting out in a critical care unit must be coached by an experienced colleague, in pairs, for at least two months. However, the high technicality should not overshadow the human aspect. The nurse must help the patient in this difficult ordeal, extend the information given by the doctor while respecting his skills and his own professional rules. It must be appropriate, intelligible and requires discretion, availability, discernment and tact to welcome everyone’s confidences and anxieties.

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