Expert Consensus on Nursing Management for Patients Undergoing Primary Percutaneous Coronary Intervention during the COVID-19 Pandemic

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Introduction

The prevention and control of the coronavirus disease (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2[1] is now more critical than ever. The National Health Commission of the People’s Republic of China classified COVID-19 as a Category B infectious disease, as stipulated by the Law of the People’s Republic of China on Prevention and Treatment of Infectious Diseases, and took preventive and control measures defined for Category A infectious diseases.[2] By January 29, 2020, the highest-level (Level I) response for major public health emergencies had been initiated against COVID-19 in 31 provinces, autonomous regions, and municipalities in China. Among the uncontrolled spread of the COVID-19 pandemic, prevention and control in China remains critical.

The outbreak of the COVID-19 pandemic coincided with the peak season for cardiovascular diseases. Therefore, while measures are taken to prevent and control COVID-19, the diagnosis and treatment of acute coronary syndromes (ACSs) should not be neglected. During the COVID-19 pandemic, it is preferable to treat ACS patients while strictly implementing the five basic principles of “Nearby Treatment, Safety Protection, Priority of Thrombolysis, Transport to Designated Hospitals, and Remote Consultation.”[3] However, if the benefits of percutaneous coronary intervention (PCI) outweigh the risks (namely the risk of disease transmission to medical personnel and the risk associated with surgery for patients), primary PCI should be considered.[4] However, for patients with suspected COVID-19, it is highly challenging to maintain infection control during the entire primary PCI process. Not only should more standardized, rapid, and effective treatment be administered to such patients but also strict prevention and control measures should be taken in accordance with the guiding principle of “concentrating patients, medical experts, resources, and treatment into special centers” to resolutely prevent the spread of COVID-19. Currently, there is little experience and a lack of effective and standardized evidence-based guidelines regarding PCI nursing management for these patients. Moreover, there is a need to provide advice regarding global nursing management for ACS patients with suspected COVID-19 requiring primary PCI.

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while maintaining pandemic prevention and control. Therefore, the Cardiovascular Nursing and Technology Training Center of the China Cardiovascular Association formed an expert group, consisting of 13 Chinese cardiovascular nursing experts with experience working in cardiac intervention centers and one expert from the hospital infection control department with experience in nosocomial infection management, to provide a consensus. The main responsibilities of this group were to oversee the development of the expert consensus, to approve the incorporation of documentary evidence, and to consult and collate expert opinions.

The consensus developed by this group defines the target population and provides guidelines for the management of patients with suspected COVID-19 or ACS requiring primary PCI when suspected COVID-19 cannot be ruled out. It aims to develop a comprehensive nursing management model encompassing the entire primary PCI process, including system development, pre-preparation, reception and transfer, preoperative preparation, intraoperative prevention and control, and postoperative management. The goal of this consensus is to satisfy clinical needs, ensure rapid and efficient treatment, achieve a zero infection rate, and prevent cross-infection among healthcare staff.

**Development of the Standard Operating Procedure**

**Set up an emergency response team**

An emergency response team should be established in the cardiac catheterization laboratory (CCL) to receive patients with suspected COVID-19 who require primary PCI. The team should be headed by the head of the cardiology department; the deputy heads of the team should be the medical subdirector and the head nurse. The team should consist of all the CCL staff, including medical and nursing technicians, customer service executives, logistics staff, and administrative support staff. There should be clear schedules and assignments of responsibilities [Figure 1] acknowledged by all staff members. It is recommended that the response team hold weekly seminars online and have emergency meetings whenever new tasks or requirements are assigned and when contingencies or emergencies are encountered. All members of the team should participate, speak out, and be heard, and should offer suggestions and feedback to improve the process.

**Strictly enforce the “daily report system” and “zero report system” for staff with a history of travel**

All staff should register their information on trips outside the province and abroad. Staff with a history of travel should not resume work upon return but instead stay at home for a 14-day isolation period (calculated from the arrival date). Self-evaluation should be carried out daily. The body temperature should not exceed 37.3°C when they resume work, and they should be assessed for COVID-19 symptoms. If any abnormalities are detected, they should be reported in a timely manner to the head of the cardiology department and the hospital infection management department and dealt with in accordance with the response plan for fever. Continuation of work despite illness should be strictly forbidden.

**Optimize the rapid deployment and procurement of protective equipment**

Timely reports should be sent to the hospital’s COVID-19 prevention and treatment working group to ensure the rapid and rational deployment of protective equipment and meet the clinical needs of the staff. Special equipment including one-piece protective clothing, goggles or protective face screens, infrared thermometers, medical protective masks, disposable shoe covers (boot covers recommended), and air disinfection machines should be fully available.

**Add an access control system for outsiders and staff**

Access should be strictly restricted to CCL personnel. Only CCL staff who are working on a given day should be allowed access, and there should be strict enforcement of the access system. In addition, entrants should fully cooperate with the receptionist for temperature measurements and relevant record keeping.

**Training and education**

To enhance their ability to manage emergency PCI patients with suspected COVID-19 and increase their awareness regarding infection prevention and control, training for the relevant system procedures, management, and protection requirements should be provided to CCL staff. Scenario simulations for relevant emergency plans should also be conducted to help the staff manage unexpected situations. All training and exercises should have a corresponding assessment, feedback, and records, and continuous improvement should be ensured. The training, education, and emergency drills should include training for additional systems, contingency plans, and process improvements; staff performance should be documented, and feedback should be provided. In addition, there should be comprehensive training and testing for special protection and hospital infection management.

**Patient Admission and Transfer**

**Establish a reporting system**

Patients must be screened by the hospital fever clinic, and cases of suspected COVID-19 should be reported
to higher authorities (such as the medical services management department, nursing department, and hospital infection control department) and recorded. When it is determined that CCL involvement will be required, emergency surgery backup personnel should be called, and they should immediately report to the department director and the head nurse.

Review and optimize the admission and transfer route

Patients should be accompanied by a physician from the chest pain center to the CCL via a dedicated passage and elevator to avoid public areas as much as possible. The patient should be taken to the designated isolated operation room (OR) and the buffer zone should be shut down. Preoperative preparation should be completed by the CCL nurse according to appropriate medical guidelines. After the operation, the patient should be transferred to the isolation ward for further observation and treatment via a dedicated elevator and passage. All staff involved in the transfer should take level II protection measures for infectious diseases as required. Patients should wear medical-surgical masks if their condition permits.

Utilize the “ISBAR” communication model for patient transfer and handover

The “ISBAR” communication model is used to focus on the two key links of the transfer process: chest pain center staff to CCL health care staff and CCL staff to isolation ward health care staff. The “ISBAR” structured communication model includes the following: I for identification, including the patient’s bed number, name, age, sex, and whether the direct online report has been completed; S for situation, including the patient’s complaints, initial diagnosis, admission details, temperature, cough, respiratory symptoms, changes in the status of the illness, related treatment, and effects; B for background, including the patient’s medical history, history of pandemic exposure, and allergies; A for assessment, including the various clinical parameters, laboratory test results, lung computed tomography results, electrocardiogram, skin wounds, safety risk assessment results, and family support; and R for recommendations, including a focus on the nursing consensus and other special handover components.

Preoperative Preparation

Procedure for the preoperative conversation to obtain consent and arrangements for family members

When a patient with suspected COVID-19 requires primary PCI, they should be accompanied by a family member who can sign the Informed Operation Consent Form. Family members should not be allowed to enter the CCL during the operation but instead wait in the family waiting area (medical protective mask required).

Nosocomial infection control in the operation room

It is preferred to designate negative-pressure ORs as isolated ORs. The return air units of the central air conditioning (laminar flow and ventilation) must be switched off if general ORs are used. All items that are temporarily or potentially not required in the OR should be removed to avoid contamination. All items needed for the operation should be adequately prepared and placed in the OR. A warning sign of “Surgeries for Infectious
Diseases, Access Limited” should be hung outside the door of the isolated OR, and personnel not involved in the surgery should not be allowed to enter the OR.

**Accurate assessment of the patient’s condition**

Respiration and oxygen saturation should be assessed before surgery. Effective oxygen therapy should be administered in a timely manner depending on the changes in the oxygen saturation,[9] and an oxygen mask is recommended. Furthermore, for patients receiving general anesthesia, it should be confirmed that the ventilator is in a good working condition. During the surgery, changes in body temperature, pulse, respiration, blood pressure, and other vital signs should be monitored strictly. Effective coordination is needed to complete the surgery quickly and safely.

**Bed units**

Two layers of disposable bed linen should be put on the surgical bed used for digital subtraction angiography. In addition, the patient transfer trolley should be placed in the OR (one trolley for one person and sterilization after use).

**Material preparation**

All equipment in the OR should be covered with disposable equipment covers to prevent contamination by the patient’s blood and body fluids.

**Personnel restrictions**

The number of personnel involved in the operation should be minimized, and nosocomial infection prevention and control should be conducted according to the national guidelines.

**Preparation of disinfectant**

Disinfectants such as 75% alcohol or hydrogen peroxide are effective for the prevention of COVID-19. Pure chlorhexidine (Hibitane) products should be avoided.

**INTRAOPERATIVE PREVENTION AND CONTROL**

**Surgical staff**

The OR should be staffed only by a surgeon, an assistant, a circulating nurse, and a control room technician to minimize the number of personnel involved in the operation. The OR personnel should be subject to level III protection against infectious diseases and not be permitted to leave the OR during the operation. Personnel outside the OR should be subject to level II protection against infectious diseases and not be allowed to enter the designated OR except in special circumstances. In case of rescue or other special circumstances, if the staff needs to enter the OR, they must ensure level III protection against infectious diseases and use the patient passage instead of the regular passage to the OR and control room. In addition, after the completion of the surgery, they should not be allowed to return directly to the control room before wearing new protective equipment and removing the potentially contaminated set.[10]

**Personal protection**

Staff involved in a surgery should not be allowed to enter the OR until they have worn personal protective equipment outside the OR.[11] All personnel performing PCI must wear and remove the protective equipment in accordance with the level III protection standards for infectious diseases.[9] The procedure for wearing equipment for level II and III protection against infectious diseases in a clean area is illustrated in Table 1. The procedure for removing the protective equipment at the end of the surgery is shown in Table 2. Classification and requirements for personal protection are listed in Table 3.

**PAS SING OF CONSUMABLES**

All disposable consumables required in the surgery should be available in the OR to reduce the need to open the OR door and pass supplies. The nurses outside the OR should record this for the surgery.

**Waste treatment**

Secondary contamination is strictly prohibited, and ground contamination should be minimized.

All consumables and packaging of the medications used in the isolated OR should be disposed as medical waste. All medical waste should be disposed in double-layered medical waste bags. The sharp instruments should go into the designated container for sharp objects.[12] Surgery should be performed using disposable surgical kits and disposable surgical instruments, dressings, and consumables whenever possible. These should be disposed directly in the medical garbage can (yellow lid) after use together with other waste; surgical instruments that will be used again should be sprayed with a sanitizer close to the bedside, and they should then be sealed, marked, and sent to the sterilization supply center.

**Personnel management**

During the operation, the staff must stay inside the OR and not leave unless essential. The operation should be performed carefully to prevent the splashing of blood and body fluids, which could lead to contamination.

**POSTOPERATIVE MANAGEMENT**

**Effectiveness of disinfection**

To ensure adequate disinfection, disinfection measures should be taken immediately after the surgery.[13]

**Protection of logistics staff**

Cleaners must wear protective equipment, such as overalls, disposable hats, medical protective masks,
disposable gloves or long-sleeved thick rubber gloves, waterproof isolation suits, protective face screens, and work footwear (with waterproof boot covers) or rubber boots, for disinfection and cleaning.

**Disinfection principle**
The “sterilize–clean–sterilize again/disinfect again” principle should be followed.[14]

**Infectious waste**
All equipment, instruments, and objects; blood, secretions, and excretions; and potentially contaminated areas including the surfaces of objects, air, and air conditioning systems used or touched by patients must, by default, be considered infectious and disinfected strictly.[15]

**Disinfection methods and disinfectant selection**
All instruments should be wiped with 1000 mg/L of an effective chlorine disinfection solution. Desks, floors, walls, surfaces of objects in the ORs, buffer zones, control rooms, and air conditioning and laminar flow systems (new air vents and return air vents) should also be disinfected with this solution. If there is contamination due to blood or secretions, the effective solution strength of the chlorine disinfectant should be increased to 2000–5000 mg/L; the solution should be sprayed and left for 30 min before it is wiped. The isolation room should be thoroughly cleaned and disinfected and then irradiated with ultraviolet light (extended irradiation for more than 1 h). Air disinfection can be carried out with a hydrogen peroxide aerosol after ensuring that there are no humans in the areas. ORs should be closed for at least 2 h before turning on the laminar flow and ventilation; they should be well ventilated and both natural and mechanical exhaustion may be performed.

After the completion of sterilization, the isolated OR can only be used again after air and surface sampling tests with approval from the department of hospital infection and disease control.

Patient contaminants (blood, secretions, drainage fluid, vomit, and excrement) should be collected in disposable containers containing 20,000 mg/L of an effective chlorine disinfection solution. After soaking

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### Table 1: Procedure for wearing equipment for level II and III protection against infectious diseases in a clean area

| Protection Level                        | Steps | Specific Process                                                                 |
|-----------------------------------------|-------|----------------------------------------------------------------------------------|
| **Level II protection against infectious diseases** | Step 1 | Six-step hand washing; change to scrubs, wear surgical shoes, remove personal items |
|                                          | Step 2 | Wear a disposable surgical cap, wear a medical protective mask, test whether it is airtight |
|                                          | Step 3 | Wear goggles or a protective face screen and shoe covers                          |
|                                          | Step 4 | Check and put on one-piece protective clothing and wear the inner latex gloves    |
| **Level III protection against infectious diseases** | Step 5 | Wear a lead apron and lead scarf (must wear protective face screen)               |
|                                          | Step 6 | Sterilize gloves with hand sanitizer and wear a sterile surgical gown             |
|                                          | Step 7 | Wear the outer sterile latex gloves to cover the cuffs of the sterile surgical gown |
|                                          | Step 8 | Complete the process in accordance with the standard operating procedure. A colleague must assist in confirming and checking that the PPE is complete, intact, and the right size; ensuring that no hair, skin, or clothing is exposed; and that the PPE does not interfere with clinical activities |

PPE, personal protective equipment

### Table 2: Procedure for removing the protective equipment after the surgery

| Area                     | Step | Specific Process                                                                 |
|--------------------------|------|----------------------------------------------------------------------------------|
| **Contaminated area in the OR** | Step 1 | Hand disinfection, take off shoe covers                                           |
|                          | Step 2 | Hand disinfection, remove the sterile surgical gown with outer gloves             |
|                          | Step 3 | Hand disinfection, remove the protective face screen and place it in the designated recycling container |
|                          | Step 4 | Hand disinfection, remove the lead apron and scarf                               |
| **Buffer area Semi-contaminated area** | Step 5 | Six-step hand washing, take off the cap of the protective clothing                |
|                          | Step 6 | Hand disinfection, remove the inner gloves                                       |
|                          | Step 7 | Hand disinfection, take off the one-piece protective clothing (roll from inside out) |
|                          | Step 8 | Hand disinfection, remove goggles, wash hands, remove disposable surgical cap and medical protective mask (do not touch the outside of the mask) |
|                          | Step 9 | Hand disinfection; staff members should supervise each other to assess the removal process and disinfect the skin and mucous membranes immediately in case of contamination, and report to the department in charge |
| **Clean area**           | Step 10 | Shower and get dressed                                                            |
for 2 h at a 1:2 ratio of contaminated solution to disinfectant solution, they should be poured into the washing chamber. Disposable containers should be disposed directly in medical waste bins. After use, goggles and hoods should be wiped with 75% alcohol or soaked in 2000 mg/L effective chlorine disinfection solution for 30 min and then wiped with a water yarn block and reserved for future use. Moreover, 75% alcohol or 2000 mg/L effective chlorine disinfection solution should be used to wipe and disinfect the used lead clothing and lead collars; the equipment should then be wiped with water yarn and hung on a lead clothing rack to dry.

The inner and outer contact surfaces of the drum should be wiped with 1000 mg/L effective chlorine disinfection solution.

The isolated elevator used by the patient should be disinfected by wiping with 2000 mg/L of an effective chlorine disinfection solution, and hydrogen peroxide aerosol should be used for air disinfection after ensuring that no human enters the area. Similarly, patient-used transfer vehicles should be wiped down with 2000 mg/L effective chlorine disinfection solution.\(^{[16]}\)

### Table 3: Personal protection classification and requirements

| Items                                      | Level I protection against infectious diseases | Level II protection against infectious diseases | Level III protection against infectious diseases |
|--------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Cap                                        | ★                                              | ★                                             | ☆                                             |
| Isolation gown                             | ★                                              | ☆                                             | ☆                                             |
| Protective clothing                        | ★                                              | ★                                             | ☆                                             |
| Disposable medical-surgical mask           | ★                                              | ★                                             | ☆                                             |
| Medical protective mask                     | ★                                              | ☆                                             | ☆                                             |
| Goggles/protective shield                  | ★ (Either)                                    | ★ (Both)                                      | ⭐                                             |
| Gloves                                     | ★                                              | ★                                             | ☆                                             |
| Long boots/protective shoe covers          | ★                                              | ☆                                             | ☆                                             |
| Breathing mask                             | ★                                              | ☆                                             | ⭐                                             |
| Sample collection (from patients who have symptoms after close contact or suspected or confirmed cases) | ☆ (Also wear the face screen)                  | ☆                                              | ⭐                                             |
| Shipping samples                           | ★                                              | ☆                                             | ☆                                             |
| Sterilization (for sites that could be contaminated) | ★                                              | ☆                                             | ☆                                             |
| Medical observation of close contacts      | ★                                              | ☆                                             | ☆                                             |
| Patient transfer                           | ★                                              | ☆                                             | ☆                                             |
| Observation of general respiratory symptoms and fever in the outpatient or emergency department | ★                                              | ☆                                             | ☆                                             |
| Entering the observation room or isolation wards to treat patients, and to clean and disinfect | ★                                              | ☆                                             | ☆                                             |
| Administration of treatment at a close range wherein aerosols could be encountered | ★ (Also wear the face screen)                  | ☆                                              | ⭐                                             |
| Handling patient’s blood, secretions, and feces | ★ (Also wear the face screen)                  | ☆                                              | ⭐                                             |

Note: ⭐ Breathing mask is not a must; use the mask if the condition allows

### Evaluation after disinfection

After the isolated OR has been sterilized, it can only be used again after air and surface sampling tests have been conducted and passed.

### Medical waste transport

Medical waste should be sealed and covered with double-layered yellow garbage bags outside the OR and subsequently transported with “COVID-19” warning labels. Designated personnel should collect this waste and take it to a medical waste station for disposal.

### Cleaning tools

Disposable cleaning tools are recommended. All cleaning tools required in the isolated OR should be kept separately and should not be mixed during use and storage.

### Registration and reporting

Patient status should be reported to the higher levels of management (such as the medical services management department, nursing department, and hospital infection control department). The physician who first diagnosed the case, i.e., the emergency physician, should fill out the Infectious Disease Report Card in a timely manner. Time nodes should be recorded in detail during the surgery according to the ACS treatment requirements.\(^{[8]}\)
The surgical registry must be marked with the words “Suspected COVID-19” in the remarks column in red for traceability.

**Establish a “medical observation” management program for surgical personnel**

When performing a primary PCI on patients with suspected COVID-19, all health-care staff should adhere to level III protection measures for infectious diseases. Health-care staff at risk of exposure in the perioperative period should be isolated for 14 days according to the standard procedures. Once a patient is diagnosed with COVID-19, it is recommended that the medical team should be observed closely for 14 days, during which their temperature should be taken twice a day and reported online to the higher-level department via the “Medical Observation Staff Details Daily Report.” If any abnormality is detected, it should be promptly reported and treated.\[^{[17]}\]

**Emergency psychological crisis intervention for patients and health-care staff**

During this unprecedented crisis, medical workers have come under tremendous stress, with some experiencing anxiety, sadness, and panic and others reporting severe insomnia and other stress reactions that can substantially affect their work and life. Some psychological assistance and crisis intervention can be provided. The psychological interventionist should listen carefully and identify with their feelings, provide emotional support, encourage self-approval, and increase self-confidence. They should encourage the health-care workers to choose an activity of their liking that will provide stress relief, such as listening to music, yelling, looking out into the distance, exercising, and crying,\[^{[16]}\] so that they can have an optimistic, hopeful, and cheerful outlook.

**Conclusion**

While confronting this major pandemic, health-care workers everywhere regard pandemic prevention and control as their top priority. Health-care staff need to make adjustments to the process of managing ACS patients. Grasping the principle of providing rapid and efficient treatment while ensuring zero infection among health-care staff and the prevention of cross-infection between patients can be challenging. The management strategies and recommendations provided in this consensus can assist the nursing management of patients undergoing cardiac interventions while ensuring pandemic prevention and control. Since the severity of and control measures for the COVID-19 pandemic vary among different regions and the distribution of medical resources is not even, hospitals at all levels can make reasonable adjustments based on this expert consensus according to their actual local situation. As the characteristics of the pandemic change and information on the disease increases, protective strategies and management plans should be updated regularly.

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**Conflicts of interest**

There are no conflicts of interest.

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