

Recommendations from the Peking Union Medical College Hospital for the management of acute myocardial infarction during the COVID-19 outbreak

Since December 2019, the outbreak of coronavirus disease 2019 (COVID-19) has increased to a public health emergency of international concern. During this time, how to balance cardiovascular emergency patients and COVID-19 control has become a global challenge. For acute myocardial infarction (AMI) patients with COVID-19, a safe and efficient medical environment should be ensured in parallel with effective reperfusion therapy.

However, most medical centres do not have professionally protected cardiac catheterization rooms and cardiac care units (CCUs) for respiratory infectious diseases. Under these circumstances, the prevention of COVID-19 needs the coordination of hospital administrators and the collaboration of multidisciplinary teams including the cardiology department, emergency department, infections department, pneumology department, radiology department, and the medical laboratory department. All together, this ensures a smooth workflow.

Based on real-world experiences in AMI management during the COVID-19 outbreak, Peking Union Medical College Hospital first proposed the following medical recommendations in China. These recommendations have been verified by the practice of many Chinese medical institutions and should be promoted worldwide for peer reference. All the contents of this recommendation are in strict accordance with the COVID-19 prevention principles of World Health Organization and the regulations from each national health authorities.

Organizing and training by the Department of Medical Affairs

Medical treatment protocols should first be developed. Medical staff from departments of cardiology, emergency, and radiology, and the cardiac catheterization room should be trained for the early recognition of COVID-19, and the disinfection measures for facilities and medical equipment used by suspected patients.

Emergency intravenous thrombolysis is the first choice for acute ST-segment elevation myocardial infarction (STEMI)

Clinical institutions should strictly abide by the law of prevention and control of infectious disease. Protecting the medical staff and other patients as well as being compliant with the principle 'Save the heart, race against time' to the maximum. Minimize the total myocardial ischaemia time for patients (*Figure 1*).

- i. For STEMI patients with confirmed COVID-19, strict isolation should start immediately, and thrombolytic contraindications should be evaluated. Patients with thrombolytic contraindications should be transferred to the local designated infectious medical institution immediately for further treatment through the first-aid transport mode designated by the government. Patients without thrombolytic contraindications should first start intravenous thrombolysis and then transfer to the local designated medical institution of infectious disease for further treatment.
- ii. For STEMI patients with suspected COVID-19 (defined as fever, respiratory symptoms, and/or epidemiological linkage to other COVID-19 cases or areas with cluster transmission), the emergency should be protected strictly according to the standard of the fever clinic. Routine blood examination, C-reactive protein, pharyngeal swab/sputum specimen/blood sample for detection of novel coronavirus nucleic acid, and chest computed tomography (CT) examination should be performed for COVID-19 confirmation. Considering the fact that most medical centres do not have professional protected interventional catheterization rooms, and the conflict between time required for novel coronavirus nucleic acid detection and early reperfusion for AMI, it is recommended to start emergency intravenous thrombolysis for STEMI patients if COVID-19 cannot be excluded in a short time. Cardiologists should be contacted for the indications and contraindications, and myocardial reperfusion therapy should be initiated within 30 min.

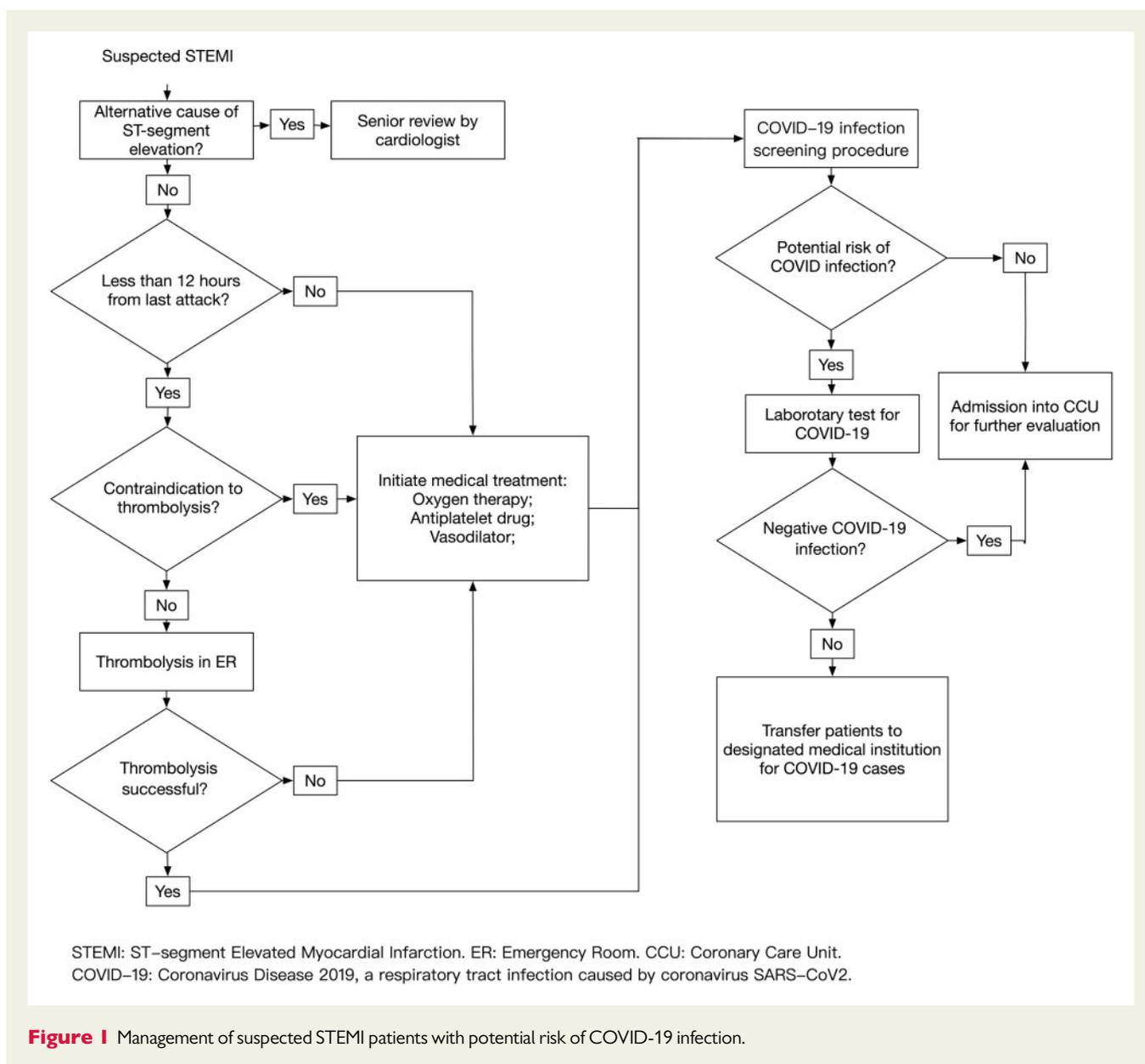


Figure 1 Management of suspected STEMI patients with potential risk of COVID-19 infection.

If COVID-19 was diagnosed after intravenous thrombolysis, patients should be transferred to the designated infectious medical institution for further treatment.

If COVID-19 and other infectious diseases were excluded after intravenous thrombolysis, patients could be transferred to the CCU. Remedial coronary interventional therapy or intensive medical treatment could be considered depending on the status of the patient's coronary artery.

Special circumstances: if COVID-19 could be excluded by the expert group within ≤ 1 h, and the possibility of having COVID-19 was clinically small, cardiologists should evaluate the following two schemes:

- Monitor closely, conduct emergency coronary intervention immediately after elimination of COVID-19.
- Proceed with onsite thrombolysis, make the treatment decision after comprehensive consideration of the benefit to risk ratio. During thrombolysis, review electrocardiogram, bedside echocardiography, and chest radiography. After thrombolysis, check the

recanalization status of myocardial perfusion and perform chest CT immediately.

- For STEMI patients with low risk of COVID-19 (defined as no fever, respiratory symptoms, and epidemiological exposure to other COVID-19 cases or areas with cluster transmission), routine blood examination, electrocardiogram, chest CT, myocardial injury biomarkers, and/or bedside echocardiography should be done immediately. Bedside chest radiography can be considered an alternative to chest CT for patients with movement disorders or uncontrollable factors. Specialists in infectious diseases should be consulted urgently for the necessity of sending pharyngeal swab/sputum specimen/blood sample for further exclusion of novel coronavirus nucleic acid.

- If the infectious disease specialists consider it unnecessary to send biological samples, patients should be transferred immediately to the cardiac catheterization room for emergency coronary interventional therapy or transferred to the CCU after intravenous thrombolysis.

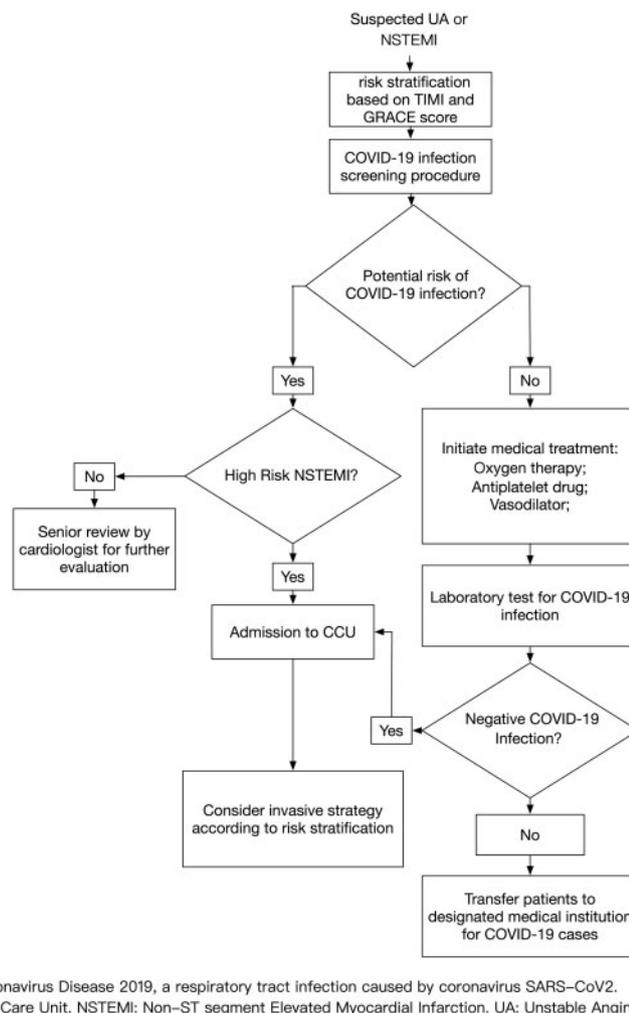


Figure 2 Management of suspected unstable angina (UA)/NSTEMI patients with potential risk of COVID-19 infection.

- b. If the infectious disease specialists consider it indispensable to send biological samples for nucleic acid detection and patients have no contraindications for thrombolysis, thrombolysis should be conducted immediately in the emergency room. Pharyngeal swab/sputum specimen/blood sample for the novel coronavirus nucleic acid detection should be sent after the start of thrombolysis. After thrombolysis, patients should be considered for transfer to the designated infectious medical institution or CCU. If the patient had thrombolytic contraindications, the result of nucleic acid detection of COVID-19 should be waited for. Patients excluded from COVID-19 should be transferred immediately to the cardiac catheterization room for emergency coronary interventional therapy, and patients diagnosed with COVID-19 should be transferred to the local designated medical institution for infectious diseases.

AMI with non-ST-segment elevation (NSTEMI)

Thrombolytic therapy in NSTEMI patients has no clinical benefit. Treatment strategies should be determined based on the risk

stratification of coronary artery diseases. Therefore, it is necessary to evaluate the existence of COVID-19 as soon as possible. The treatment strategy should be based on the GRACE risk stratification while waiting for the results of novel coronavirus nucleic acid detection (Figure 2).

- i. Confirmed patients with COVID-19 should be transferred to the designated medical institution immediately for further treatment.
- ii. For NSTEMI patients who are suspected to have or are unable to be excluded from COVID-19, the following principles should be followed.
 - a. Consult specialists on infectious diseases or respiratory physicians from designated medical institutions to confirm COVID-19 as soon as possible. Chest CT and novel coronavirus nucleic acid detection should be performed immediately for suspected cases.
 - b. If COVID-19 can be excluded by the infectious disease specialist according to chest CT, it is recommended to choose a treatment strategy according to the risk stratification of NSTEMI-ACS: intervention or medication.
- iii. If COVID-19 cannot be excluded by chest CT, routine medical treatment of NSTEMI should be given and risk stratification



Figure 3 Cardiology Department group, Peking Union Medical College Hospital, in front of the very famous old building built in 1917, funded by The Rockefeller Foundation, very close to the Forbidden City.

should be conducted while waiting for the results of nucleic acid detection. For patients with low or middle risk, routine medical therapy including oxygen inhalation, coronary artery dilatation, and antithrombotic treatment should be given in the emergency room. Blood oxygen saturation and other clinical data should be monitored closely for the prevention of malignant arrhythmia. For patients with high or extremely high risk, especially those with haemodynamic instability and strong indications for immediate interventional treatment, the high-level infection control panel should be started, and two or more specialists should co-determine the risk of COVID-19. If the risk of COVID-19 is con-

sidered high, patients should be transferred to the local designated medical institution for interventional treatment and enhanced supportive treatment.

- iv. While waiting for the confirmation of COVID-19, efforts should be made to identify the patient's aetiology. If viral infection was a contributing factor or cause of myocardial injury, type 2 myocardial infarction should be diagnosed. The treatment strategy of type 2 myocardial infarction should be mainly based on the primary diseases. Therefore, CT coronary artery scan should be completed at the same time as chest CT examination for better determination of treatment strategy. In addition, risk factors of acute pulmonary embolism, such as ortho-

paedic surgery, tumour, and deep vein thrombosis, should be investigated. Blood oxygen saturation, D-dimer, and ultrasound for thrombosis in lower limb deep veins should be performed to exclude acute pulmonary embolism. When necessary, CT pulmonary angiography could be completed at the same time as chest CT. Clinicians need to be on high alert for misdiagnosis between pulmonary infarction induced by acute pulmonary embolism and COVID-19. Clinicians should also strengthen their vigilance of chest pains caused by aortic dissection or acute myocarditis.

- a. For NSTEMI patients excluded from COVID-19, early or time-limited intervention strategies should be selected immediately according to the risk stratification of NSTEMI-ACS. Patients should be enrolled into the CCU for further intensive medical therapy including oxygen inhalation, coronary artery dilatation, and antithrombotic treatment.

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Appendix

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