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Review

Operating room team safety and perioperative anesthetic management of patients with suspected or confirmed novel corona virus in resource limited settings: A systematic review

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ABSTRACT

Background: Novel Corona Virus is a pandemic infectious disease which affects all age groups with higher incidence in geriatric population and chronic diseases. Contact, droplet and airborne had a role for transmission of the disease during airway manoeuvres in infected patients. This study aimed to prepare the operation room and provide protection of both the patient and health care personnel.

Method: This systematic review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) protocol. Search engines like Pub Med through HINARI, Cochrane database, Google Scholar to get access for current and updated evidences on operating room team safety and perioperative anesthetic management for patients with suspected or confirmed novel corona virus.

Discussion: High risk procedures for aerosolization including endotracheal intubation, open lung surgery and airway suctioning should be managed with vented masks.

Conclusion: All health care personnel should wear personal protective equipment based on the class of patients during surgery. Elective procedures should be postponed to save and mobilize resources for the protection and management of the pandemic disease. Emergency procedures including burn, Cesarean section, malignant neoplasia, perforated viscus and traumatic injury should be operated with wearing of personal protective equipment.

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https://doi.org/10.1016/j.tacc.2020.06.011
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1. Introduction

Novel Corona Virus disease (COVID-19) is a pandemic infectious disease caused by a novel corona virus worldwide which affects all age groups with higher incidence in geriatric population and chronic diseases [1–4]. Airborne transmission may occur if patient respiratory activity or medical procedures generate respiratory aerosols. Contact, droplet and airborne transmission are each relevant during airway manoeuvres in infected patients, particularly during tracheal intubation [5].

Anesthesia providers play a vital role in providing in-hospital intubation. The safety of the patient and the individuals who are involved in the intubation requires special consideration and precautions [6,7]. Patients are shown to be positive for novel corona virus pneumonia after screening with reverse transcription polymerase chain reaction (RTPCR) and will have symptoms of fever, headache, cough, and chills. Severe bilateral pneumonia, acute respiratory

| Levels of evidence and degree of recommendations. |
|--------------------------------------------------|
| **Level** | **Types of evidence** | **Degree of recommendation** |
| **1a** | Meta-analysis, systematic review of RCTs, Evidence based guidelines | Strongly recommended and directly applicable |
| **1b** | Systematic review of one RCT | Highly recommendable and directly applicable |
| **1c** | Randomized control/clinical trials | Recommended and applicable |
| **2a** | Systematic review of cohort or case control studies | Extrapolated evidence from other studies |
| **3a** | Non-analytical studies like case report and case series, clinical audit, commentaries and export opinions | Extrapolated evidence from other studies |

**Source:** Good clinical practice, GCP, WHO, 2011.

| Risk categories of COVID 19 | Personal protective equipment recommendation |
|----------------------------|---------------------------------------------|
| **Class I patients**       | Grade 1 protection |
| 1. Disposable surgical cap and surgical garments |
| 2. Disposable gloves |
| 3. Surgical mask |
| 4. Protective goggles with sterilized surgical gowns during tracheal intubation. |
| **Class II patients**      | Grade 2 protection |
| 1. Disposable surgical cap and disposable impermeable surgical gown (isolation gown) |
| 2. Protective goggles and head shield, disposable gloves |
| 3. Medical surgical mask and medical N95 mask |
| 4. Disposable shoe covers. |
| **Class III patients**     | Grade 3 protection |
| 1. Disposable surgical cap, scrubs, and disposable impermeable surgical gown (isolation gown) |
| 2. Protective goggles and head shield, double-layer disposable latex gloves |
| 3. Medical N95 masks; a positive pressure headgear is recommended for tracheal intubation |
| 4. Disposable boot cover. |

**Table 2**

Personal protective equipment and risk categories of COVID 19 Patients.
failure and acute respiratory distress syndrome will be manifested later [8–11]. The principles for airway management should be the same for all patients with COVID-19 (asymptomatic, mild or critically ill) [12]. The goal of this systematic review was to prepare the operation room and provide protection of both the patient and health care personnel.

2. Methods

This systematic review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) protocol [13]. Search engines like Pub Med through HINARI, Cochrane database, Google Scholar to get access for current and updated evidences on operating room team safety and perioperative anesthetic management for patients with suspected or confirmed novel corona virus. Key words including COVID 19 AND Intubation, COVID 19 AND Exubation, COVID 19 AND PPE, COVID 19 AND Emergency surgery, COVID 19 AND Elective surgery, COVID 19 AND Operation Room, COVID 19 AND, COVID 19 AND Perioperative anesthetic management were used. A publication with English language that was done in 2020 was included in this systematic review. Review articles, systematic reviews, case reports, observational studies and retrospective studies were included (Fig. 1). This review article has been registered with UIN of reviewregistry938.

After comprehensive and in-depth appraisal of literatures, Table 3

| Recommendations for PPE in operating area. |
|---------------------------------------------|
| **Health Care Personnel (HCP)** | **Recommendations** |
| Patient transport in and from OR | All person involved in transportation should wear surgical masks like surgical FFP1–3, N95–100, level 1 surgical gown and gloves. |
| Transfer of patient into OR area | All HCP should wear surgical masks like FFP1–3, N95–100. Level 1 surgical gown,gloves and eye protection |
| Intubation and initiation of anesthesia in OR | All HCP in OR should wear surgical masks > FFP2/N95FFP3, N99, > level 3 surgical gown, eye protection indicated if less than 2 m distance and gloves. |
| Surgery including surgical, Aerosol Generating Procedures | All HCP in OR should wear surgical masks > FFP3/N99FFP3, N99, > level 3 surgical gown, eye protection indicated if less than 2 m distance and gloves. |
| Surgery including respiratory Aerosol Generating Procedures | All HCP in OR should wear surgical mask > FFP2/N95FFP3, N99, > level 3 surgical gown, eye protection indicated if less than 2 m distance and gloves. |
| Extubation and ending of anesthesia in OR | All HCP in OR should wear > FFP2/N95FFP3 N99, > level 3 surgical gown,eye protection indicated if less than 2 m distance and gloves |
| Cleaning of OR | Cleaning personnel should wear masks > FFP2/N95FFP3 N99, > level 3 surgical gown,eye protection and gloves |

Table 4

| Summary of evidences. | Authors/ Type of study | Settings | Participants | Objectives | Conclusions | References |
|------------------------|------------------------|----------|--------------|------------|-------------|-----------|
| Weixia et al./2020 | Review article China-Japan Friendship Hospital, Beijing, China | Patients and health care providers with confirmed or suspected 2019 nCoV | Risk categories of COVID 19 patients? Personal protective materials? | Class I patients (excluded from COVID 19)- recommended to wear Grade 1 protection (Table 1). Class II patients have negative screening tests but fever or lung imaging suggestive of COVID-19 changes. Grade 2 protection is recommended (Table 1). Class III patients are those who need emergency surgery prior to screening for novel corona virus pneumonia or suspected or confirmed cases of novel corona virus pneumonia that require emergency surgery. Grade 3 protection is recommended (Table 1). Aerosols can cause transmission of infectious viral particles. Invasive ventilation system must be opened, and endotracheal intubation is associated with an increased risk of infection. CPAP/NIV therapy can be administered under use of a mouth and nose mask or a respiratory helmet as therapy escalation with continuous monitoring. In acute hypoxemic respiratory insufficiency, NIV should be performed in ICU with personnel with appropriate expertise. Personal protective equipment should be worn by all intubating health workers Hypoxemia during intubation, hypotension, cardiac arrest and pneumothorax were happened complications in COVID 19 patients. COVID patients developed severe AEDS requiring intubation and prone positioning to maintain adequate oxygenation. | | [11] |
| Pleifer et al./2020 | Review article | The German Society for Pneumology and Respiratory Medicine | COVID-19 patients suffering from acute respiratory insufficiency | Prognosis of acute respiratory insufficiency? Insufflations of Oxygen Flow of oxygen? Mode of ventilation in infected patients and ARI? | | [15] |
| Yao et al./2020 | Retrospective observational case series | Retrospective observational case series from Wuhan, China | COVID-19 patients | PPE? Complications in COVID 19? Cross infection time? | | |
| Admas et al./2020 | Case report | West Virginia University, Medical Center | 67-year-old male, presented with acute respiratory failure.COVID-19 | Complications and management in COVID 19? | | |
| Caputo et al./2020 | Pilot study | Emergency Department in New York City. | Patients suspected of having COVID19 with hypoxia on arrival | Use of early proning of non-intubated patients in the emergency department during the COVID-19 pandemic. | | |

After 5 min of proning the patient the SpO2 well improved with supplemental oxygenation with non-breather mask and nasal cannula.
evaluation of quality was conducted by categorizing them based on Good clinical practice, GCP, WHO, 2011, into level 1a (Meta-analysis, systematic review of RCTs, Evidence based guidelines) Tbl (Systematic review of one RCT), 1c (RCTs), 2a (Systematic review of cohort or case control studies) and 3a (Non-analytical studies like case report and case series, Clinical audits, commentaries). Finally, conclusion had been drawn based on the level of evidences.

3. Discussion

The goal of this systematic review was to prepare the operation room and provide protection of both the patient and health care personnel. Tracheal intubation in COVID-19 patients creates a risk to physiologically compromised patients and to attending healthcare providers. Clinical information on airway management and expert recommendations in these patients are urgently needed [14].

3.1. Aerosol generating procedures

Aerosols can cause transmission of infectious viral particles. Bronchoscopy, endotracheal intubation, laparoscopy, open lung surgery, colonooscopy, tracheal surgery, including tracheostomy are high risk procedures for aerosolization and potential viral particle transmission. Bronchoscopy, endotracheal intubation, laparoscopy, open lung surgery, colonooscopy, tracheal surgery, including tracheostomy are high risk procedures for aerosolization and potential viral particle transmission. Social distancing is the best mechanism available to protect patients and health care workers from infection. Mother/baby separation avoids transmission, Vertical transmission has not been confirmed, Surgical and non-surgical patients may be affected by COVID-19. 25% of COVID-19 disease required mechanical ventilation with positive airway pressure. Bronchoscopy, endotracheal intubation, laparoscopy, open lung surgery, colonooscopy, tracheal surgery, including tracheostomy are high risk procedures for aerosolization and potential viral particle transmission. Surgical and non-surgical patients may be affected by COVID-19. 25% of COVID-19 disease required mechanical ventilation with positive airway pressure.

Table 5
Summary of evidences.

| Authors/year | Type of study | Settings | Participants | Objectives | Conclusions | References |
|--------------|---------------|----------|--------------|------------|-------------|------------|
| Dondorp et al./2020 | Review article | Amsterdam University Medical Centers | COVID-19 patients focus on resource-limited settings. | Best provision of ventilatory support, with a focus on resource-limited settings. | Supplemental oxygen is a first essential step in resource-limited settings where capacity for invasive ventilation is limited. | [8] |
| Dotter–catz et al./2020 | Review Article | New York, USA | Pregnancy and COVID 19 | Pregnancy and COVID 19? | Social distancing is the best mechanism available to protect patients and health care workers from infection. | [28] |
| Heffeman et al./2020 | Review article | USA | Adult COVID 19 patients | Protection of staffs and patients from COVID 19. Infected adult patients requiring urgent or emergent operative interventions | Social distancing is the best mechanism available to protect patients and health care workers from infection. | [28] |
| Hernandez et al./2020 | Review article | Sociedad Española de Anestesiología | COVID 19 Patients | What was the possible treatments of COVID 19 | Vitamin C, a potent antioxidant, has emerged as a relevant therapy due to its potential benefits when administered intravenously. | [29] |
| Zhonghua et al./2020 | Review article | China | COVID 19 patients | Reduction of transmission of disease and optimization? | Reducing inflammation in the lungs could play a key role in lung injury caused by corona virus infection. | [16] |

Table 6
Summary of evidences.

| Authors/year | Type of study | Settings | Participants | Objectives | Conclusions | References |
|--------------|---------------|----------|--------------|------------|-------------|------------|
| Heinzinger et al./2020 | Case report | California, USA | COVID 19 patients | Treatments of COVID 19 Patients | Nebulizer treatments, bi-level positive airway pressure ventilation, endotracheal intubation, were recommended Health care facilities should emphasize early recognition and isolation of patients with possible COVID-19 | [22] |
| Cook et al./2020 | Narrative review | Royal United Hospital NHS Trust, Bath, UK | COVID 19 patients | Transmission of disease? | Use the recommended PPE Airborne transmission may occur if patient respiratory activity or medical procedures generate respiratory aerosols. Contact, droplet and airborne transmission are each relevant during airway manoeuvres in infected patients, particularly during tracheal intubation. | [5] |
| Radovanovic et al./2020 | A Management Strategy Proposal | Italy | COVID-19 patients | Clinical manifestations? Management options? | Acute hypoxic respiratory failure secondary to bilateral pulmonary infiltrates, acute respiratory distress syndrome. The application of a continuous positive airway pressure by means of a helmet can represent an effective alternative to recruit diseased alveolar units and improve hypoxemia. Avoiding high-flow nasal oxygen. | [30] |
| Ahmad et al.2020 | Case report | London, UK | Awake tracheal intubation and surgical tracheostomy | How to reduce aerosol generation from COVID 19 | Establishing conscious sedation with remifentanil before commencing airway topicalisation. Avoiding transstracheal local anaesthetic infiltration. | [18] |
| Macham et al./2020 | Contemporary Review | Florida, USA | Patients who become severely ill from COVID-19 | Risks of tracheostomy in COVID 19? Bronchoscopy in COVID 19 patients? | A high likelihood of needing prolonged intubation, making tracheostomy a likely consideration. If tracheostomy is performed, we recommend a bedside approach to limit exposure time and number of exposed personnel. Bronchoscopy use with a percutaneous approach should be limited in order to decrease viral exposure. | [25] |
surgery, percutaneous endoscopic gastrostomy, esophagogastrroduodenoscopy, colonoscopy, tracheal surgery, tracheostomy, noninvasive ventilation, suctioning of the patient, transportation of patients, high-flow nasal cannula, and manual ventilation by resuscitator were some of the high-risk procedures for aerosolization. Open systems (vented masks) can prevent the release of respirable particles [1,15–17].

In awake tracheal intubation in a suspected COVID-19 patient with critical airway obstruction: avoiding high-flow nasal oxygen, establishing conscious sedation with remifentanil before commencing airway topicalisation and avoiding transtracheal local anesthetic infiltration were some of reduction mechanisms of

### Table 7
Summary of evidences.

| Authors/ Year | Type of study | Settings          | Participants          | Objectives                                                                 | Conclusions                                                                 | References |
|---------------|---------------|-------------------|-----------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------|
| Sommer et al./ 2020 | Review Article | Canadian society of otolaryngology | COVID 19 patients | Risks of tracheostomy in COVID 19 patients. Ventilation mode in COVID 19 patient | The tracheotomy procedure is highly aerosol generating and directly exposes the entire surgical team to the viral aerosol and secretions, thereby increasing the risk of transmission to healthcare providers. Extended endotracheal intubation should be the standard of care for the entire duration of ventilation in the vast majority of patients. Pre-operative COVID-19 testing is highly recommended for any non-emergent procedure. Avoiding tracheotomy procedures in patients who are COVID-19 positive if at all possible. Appropriate PPE and environment are made for COVID-19 positive, negative and unknown patients requiring consideration of tracheotomy. | [26] |
| Hirschman et al./ 2020 | Systematic review | Orthopedic surgeons working in a COVID19 environment | Recommendation of PPE? | | Level 1, 2, 3, 4 surgical gowns, faces shields or goggles, double gloves, [19] FFP2-3 or N95-99 respirator masks. Telemedicine can be considered as electronic personal protective equipment by reducing the number of physical contacts and risk contamination. | [19] |
| Steward et al./ 2020 | Review article | Healthcare teams | Age and COVID 19? PPE? | | Patients with advanced age and co morbidities have a higher incidence of mortality. For COVID-19 positive or suspected patients, the use of N95 respirators is recommended if available. Negative pressure rooms are strongly preferred for intubation/extrubation. | [4] |
| Uppal et al./ 2020 | Review article | Thoracic surgery | Thoracic surgery and COVID 19 | | Postpone elective surgery. General anesthesia with airway intervention leads to aerosol generation, both tracheal intubation and extubation. Provision of regional anesthesia may be key during this pandemic. | [17] |
| Wali et al./ 2020 | Case report | Thoracic surgery | Thoracic surgery and COVID 19 | | Severe pneumomediastinum in intubated patients with COVID-19 pneumonitis due to use of larger bore tracheal tubes and higher ventilation pressures. | [31] |

### Table 8
Summary of evidences.

| Authors/ Year | Type of study | Settings          | Participants          | Objectives                                                                 | Conclusions                                                                 | References |
|---------------|---------------|-------------------|-----------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------|
| Brewster et al./ 2020 | Review article | Staffs of emergency intubation | Early/late intubation? Principles of airway management? | Early intubation should be considered to prevent the additional risk to staff of emergency intubation and to avoid prolonged use of high flow nasal oxygen or non-invasive ventilation. The principles for airway management should be the same for all patients with COVID-19 (asymptomatic, mild or critically ill). We recommend to perform chest X-rays in the days following the onset of mechanical ventilation even if the immediate monitoring suggests an improvement. Burns are an acute-care condition, and burn treatment needs to be initiated before COVID-19 infection status can be excluded. Extensive burns requiring the establishment of venous access for rehydration, endotracheal intubation or tracheostomy, wound treatment, and surgery are the risk points for exposure to infection, severe obesity (BMI ≥ 35 kg/m2) was associated with ICU admission history of heart disease and obesity (BMI ≥ 30 kg/m2) were independently associated with the use of IMV. | [12] |
| Fichera et al./ 2020 | Review article | COVID 19 Patients with severity features | Radiological imaging before mechanical ventilation or after? Is burn patients postponed or not? General precaution if procedure performed? | | Burns are an acute-care condition, and burn treatment needs to be initiated before COVID-19 infection status can be excluded. Extensive burns requiring the establishment of venous access for rehydration, endotracheal intubation or tracheostomy, wound treatment, and surgery are the risk points for exposure to infection, severe obesity (BMI ≥ 35 kg/m2) was associated with ICU admission history of heart disease and obesity (BMI ≥ 30 kg/m2) were independently associated with the use of IMV. | [32] |
| Huang et al./ 2020 | Review article | Burn patients | | | Burns are an acute-care condition, and burn treatment needs to be initiated before COVID-19 infection status can be excluded. Extensive burns requiring the establishment of venous access for rehydration, endotracheal intubation or tracheostomy, wound treatment, and surgery are the risk points for exposure to infection, severe obesity (BMI ≥ 35 kg/m2) was associated with ICU admission history of heart disease and obesity (BMI ≥ 30 kg/m2) were independently associated with the use of IMV. | [20] |
| Kalligeros et al./ 2020 | Review article | Patients hospitalized with COVID-19 with chronic disease | Is obesity and chronic disease associated with ICU admission? | History of heart disease and obesity (BMI ≥ 30 kg/m2) were independently associated with the use of IMV. | | [3] |
| Malik et al./ 2020 | Systematic review | COVID 19 Patients | The advantages of aerosol box? | | To protect healthcare workers performing aerosol generating procedures, specifically tracheal intubation, by providing a physical barrier to droplet and/or aerosol exposure. | [33] |
| Shalish et al./ 2020 | Systematic review | Neonate and infant patients | Incidence of COVID 19 in Neonate, infants and precautions | | The risk of severe or critical illness in young patients existed. All routinely used types of support, with the addition of viral filters, proper personal protective equipment and placement of infants in isolation rooms, ideally with negative pressure. | [2] |
aerosols transmission of infectious [17,18]. The Level of respiratory aerosol to the surgeon in ENT, Neurosurgery, and Ophthalmology is high while; in Orthopedics is low [19].

3.2. Personal protective equipment and risk categories of COVID 19

Class I patients are those who have been shown to be negative for novel corona virus symptoms, laboratory examinations and imaging but still are highly suspected. Class II patients have suspected cases with manifestations of fever, cough and lung imaging abnormalities. Class III patients are those confirmed cases of novel corona virus. When those classes of patients came for emergency surgery, should be done with isolated room while elective cases transferred to a designated COVID-19 hospital and waited as others. Grade of recommendations for Personal Protective Equipment (PPE) were explained below (Table 2) [11,16].

Urgent or emergency operative intervention for time-sensitive disease processes such as malignant neoplasia, true emergencies such as perforated viscus, traumatic injury and burn should be continued with PPE while elective surgery should be postponed because of resource limitation and optimization of respiratory problems [1,17,20].

3.3. Recommendations for PPE in operating area for suspected or COVID-19 positive patients

Level 1, 2, 3 and 4 surgical gowns, face shields or goggles, double gloves, FFP2-3 or N95-99 respirator masks and teledicine (in teaching Hospital when seniors are consulted for decreasing number of healthcare personnel) can be considered as personal
protective equipment by reducing the number of physical contacts and risk contamination (Table 3) [11,16,19].

3.4. Intubation and COVID-19 at peri-operative period

Compression of the cricoids cartilage is helpful when exposure of the cord is difficult and the patient’s fasting time is unknown. Suction machine should be always available for incase of suctioning is readily needed. Assisted mask ventilation is not recommended to avoid virus scattering. If positive mask ventilation is must it is recommended to cover the area around the patient’s mouth and nose with wet gauze to help prevent virus spreading. Also muscle relaxants are recommended to reduce positive mask ventilation [21–23].

Tracheal intubation should be performed by an experienced anesthetist with an experienced assistant to maximize patient safety. Confirming the depth of the endotracheal tube is extremely difficult using auscultation while wearing isolation suits. It is recommended instead to observe bilateral chest expansion, ventilator breathing wave form and respiratory parameters. End-tidal CO2 is a better indicator of successful tracheal intubation, as oxygen saturation is not always increased immediately after intubation in these patients, because the oxygen exchange is significantly impaired [14,23,24].

Repeated tracheal intubation attempts could potentially increase virus spread, so a laryngeal mask should be inserted after an intubation failure. Fogging of goggles is a serious problem during rapid intubation, which can make intubation and airway management a major challenge for the care provider. Poor visibility also increases the risk for potential injury and infection. One solution to the problem of fogging may be to cover the inner side of the goggles with a layer of antifogging agent, such as transparent hand sanitizer [21,24].

Bronchoscopy use with a percutaneous approach should be limited in order to decrease viral exposure. Thorough pre-procedural planning, use of experienced personnel, enhanced PPE where available [25]. The tracheotomy procedure is highly aerosol generating and directly exposes the entire surgical teams to the viral aerosol plume and secretions, thereby increasing the risk of transmission to health care providers. Extended endotracheal

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**Fig. 2.** (continued).
intubation should be the standard of care for the entire duration of ventilation in the vast majority of patients. Pre-operative COVID-19 testing is highly recommended for any non-emergent procedure. Avoiding tracheotomy procedures in patients who are COVID-19 positive if at all possible. Appropriate PPE and environment are made for COVID-19 positive, negative and unknown patients requiring consideration of tracheotomy [25,26].

3.5. Summary of evidences

Table three summarized about cross transmission of infection, personal protective equipment, complications and management, mode of ventilation and risk categories of COVID 19 patients (Table 4).

Pregnancy and COVID 19, ventilatory provision in resource limited setup, how to reduce nosocomial transmission and optimization, protection of staffs from COVID 19, infected patients and urgent surgery and the recommended treatments of COVID 19 patients are summarized as follow (Table 5).

Risks of bronchoscopy and tracheostomy in COVID 19, how to reduce aerosol generation from COVID 19, transmission of diseases and clinical manifestations in COVID 19 are summarized in the below table (Table 6).

Thoracic surgery and COVID 19, intubation and COVID 19, extubation and COVID 19, elective surgery and COVID 19, ventilation mode in COVID 19, age and COVID 19 are summarized with the following (Table 7).

Early or late intubation, principles of airway management, incidence of COVID 19 in neonate, infants and its precautions, the advantages of aerosol box, obesity and chronic disease associated with ICU admission, radiological imaging before mechanical ventilation or after and burn patients and COVID 19 are summarized with the following (Table 8).

4. Conclusions and recommendations

In this systematic review we identified that patients risk should be categorized to made decision on surgery. All health care personnel should wear personal protective equipment based on the class of patients during surgery. Elective procedures should be postponed due to this pandemic disease. Emergency procedures including burn, Cesarean section, malignant neoplasia, true emergencies such as perforated viscus, traumatic injury should be carried out by wearing personal protective equipment (Fig. 2).

Ethical approval

Not required.

Funding

Nil.

Declaration of competing interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acronyms and Abbreviations

| Acronym | Definition |
|---------|------------|
| ARDS   | Acute Respiratory Distress Syndrome |
| BMA    | Body Mass Index |
| BiPAP  | Bi-level Positive Airway Pressure |
| CPAP   | Continuous Positive Airway Pressure |
| ICU    | Intensive Care Unit |
| HCP    | Health Care Personnel |
| NIV    | Non Invasive Ventilation |
| OR     | Operation Room |
| PPE    | Personal Protective Equipments |
| RTPCR  | reverse transcription polymerase chain reaction |

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tacc.2020.06.011.

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