COVID-19
重症病人
呼吸治療臨床處置

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2020/12/19

大綱

- 關於 COVID-19
- 氧氣治療
- 非侵襲性呼吸器
- 重症病人處置
- 清潔消毒
- 案例分享

疾病簡介

- 2019年12月起，中國湖北省武漢市發現多起病毒性肺炎群聚，多數與武漢華南海鮮城活動史有關，世界衛生組織將該肺炎命名COronaVIrus Disease 2019 (COVID-19)，而造成此疫情的新型冠狀病毒命名為“ Severe Acute Respiratory Syndrome COronaVirus 2 (SARS-CoV-2) ”
- 此疫情在中國其他省市擴散，亦造成泰、日、南韓、美等國境外移入疫情，國內於2020/1/21出現第一起境外移入確診個案，均有武漢旅遊史
- 我國於2020/1/15日公告「嚴重特殊傳染性肺炎」為第五類法定傳染病

致病原

- COVID-19 的冠狀病毒為 β 冠狀病毒，與嚴重急性呼吸道症候群 (severe acute respiratory syndrome，SARS) 病毒屬同一亞類。
- 其進入呼吸道上皮細胞受體結合器 (angiotensin-converting enzyme 2、ACE2) 亦與SARS-CoV 冠狀病毒肺炎致病機轉相同

傳播途徑

- SARS-CoV-2 的傳播與流感病毒相同
- 主要是通過呼吸道飛沫傳染
  - 當感染者打噴嚏、咳嗽或說 話時，透過飛沫的傳播吸入人體，病毒與呼吸道 粘膜接觸感染進入肺部組織而導致發炎，呼吸道飛沫傳播風險距離為一至兩公尺以內。
- 接觸傳染，透過觸摸有病毒污染的物體表面，然後觸摸黏膜如眼睛、鼻子或口腔進入人體組織發生感染。
- 糞便亦有報告可檢測到此病毒，因此糞口傳染似乎也可能是 SARS-CoV-2 傳染途徑

臨床表現與嚴重程度

- 目前已知罹患 COVID-19 確診個案之臨床表現包含發燒、乾咳、倦怠，約三分之一會有 呼吸急促。其他症狀包括肌肉痛、頭痛、喉嚨痛、腹瀉等，另有部分個案出現嗅覺或味覺喪失（或異常）等。
- 依據目前流病資訊，患者多數能康復，少數患者嚴重時將進展至嚴重肺炎、呼吸道窘迫症候群或多重器官衰竭、休克等，也會死亡。死亡個案多具有潛在病史，如糖尿病、慢性肝病、腎功能不全、心血管疾病等。
- 報告指出，約有 14% 出現嚴重症狀需住院與氧氣治療，5% 需加護病房治療。
- COVID-19患者以成人為主，少數兒童個案多為其他確診成人患者之接觸者或家庭群聚相關。

臨床進展

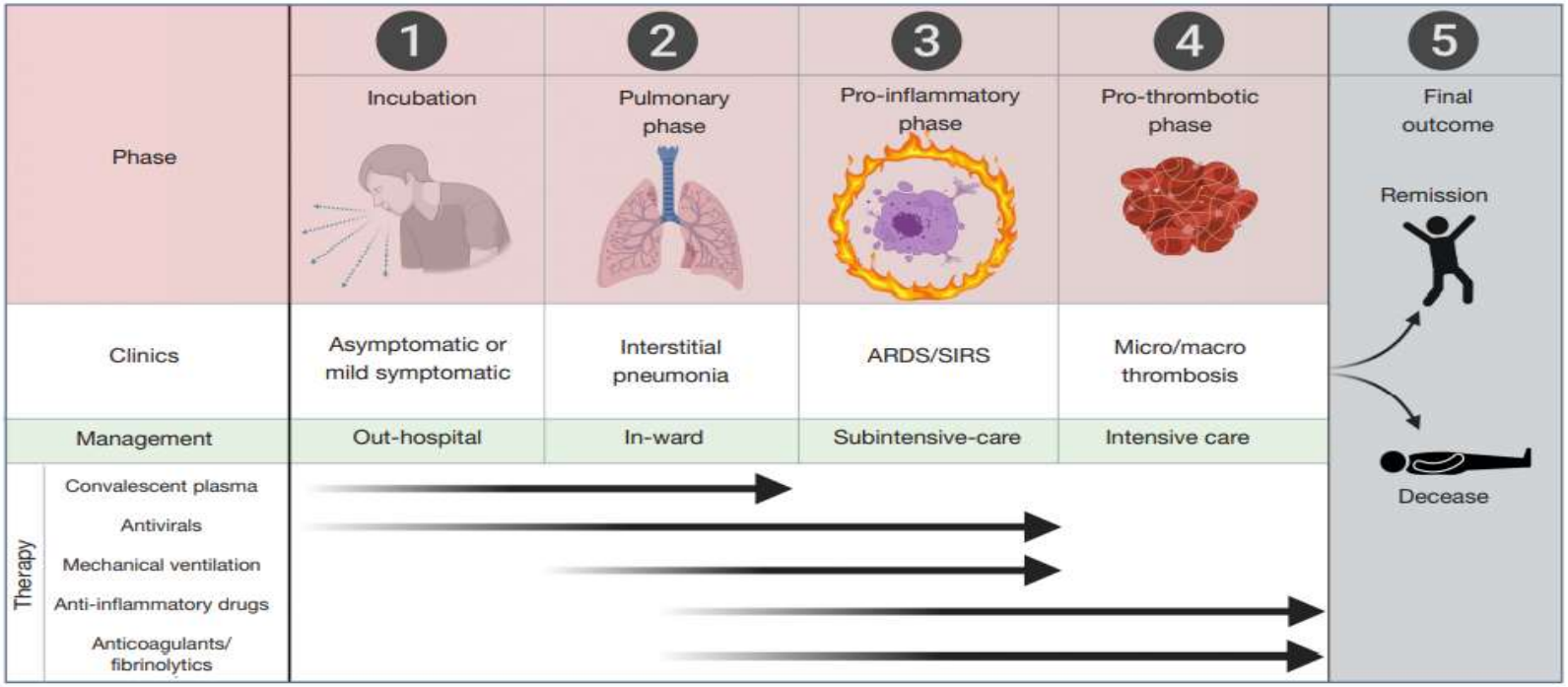


Figure 1 Phases, clinical progression, management and available therapies of COVID-19. ARDS, acute respiratory distress syndrome; SIRS, severe inflammatory response syndrome.

Ann Transl Med 2020;8(11):693

Aerosol Generating Medical Procedures (AGMPs)

- Aerosol-generating medical procedures (AGMPs) are increasingly being recognized as important sources for nosocomial transmission of emerging viruses.

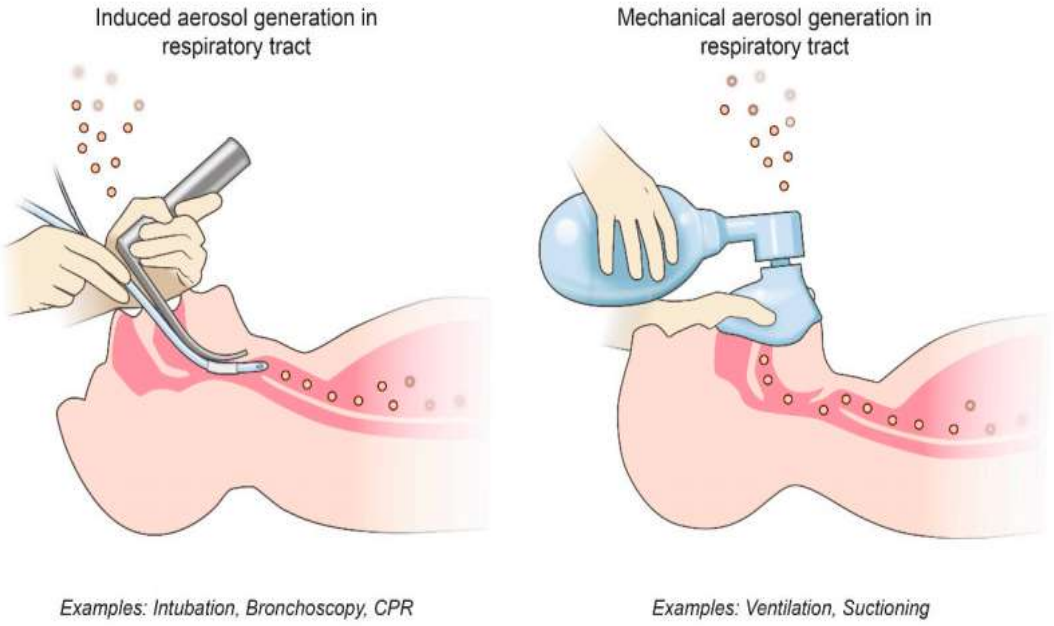


Table 1. Potential aerosol-generating medical procedures involved in nosocomial virus transmission.

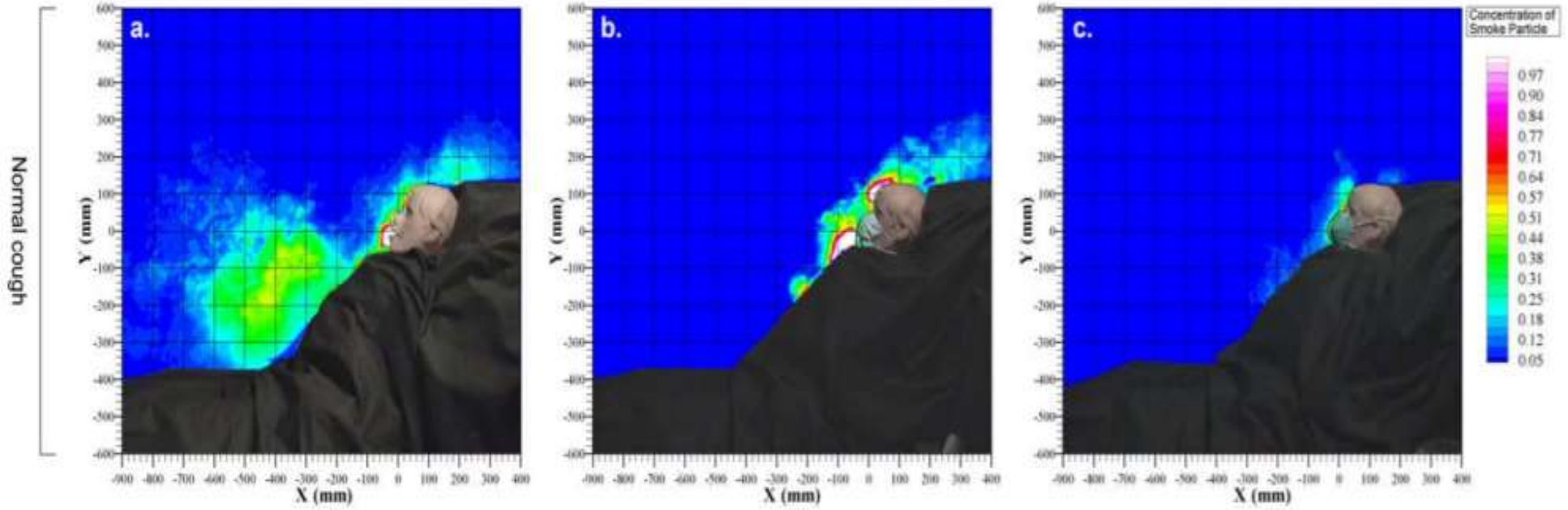
AGMP	How/Where Aerosols May Be Generated
Bronchoscopy *	Induced cough, respiratory tract
Cardiopulmonary resuscitation *	Induced cough, respiratory tract
Noninvasive ventilation * (BiPAP, CPAP, HFOV)	Possible mechanical dispersal of aerosols, respiratory tract
Tracheal intubation *	Induced cough, respiratory tract
Manual ventilation *	Possible mechanical dispersal of aerosols, respiratory tract
Surgery	Cutting bone and tendon, and irrigation aerosolize blood
Sputum induction	Induced cough, respiratory tract
Nebulizer treatment	Possible mechanical dispersal of aerosols, respiratory tract
Suctioning	Possible mechanical dispersal of aerosols, respiratory tract
Laser plume	Mechanical dispersal of aerosols

* Possible association with SARs-CoV transmission [11–13].

Viruses 2019, 11, 940; doi:10.3390/v11100940

Exhaled Air Dispersion during Coughing with and without Wearing a Surgical or N95 Mask

David S. Hui[1,2*], Benny K. Chow[2,3], Leo Chu[4], Susanna S. Ng[1], Nelson Lee[1,2], Tony Gin[4], Matthew T. V. Chan[4]



PLoS ONE 2012; 7(12): e50845. doi:10.1371/

Aerosol dispersion during various respiratory therapies

Respiratory therapy	Maximum exhaled air distance (m)
Non-invasive positive pressure ventilation	
ResMed Mirage mask (inspiratory/expiratory positive airway pressure, cmH_2O)*	
10/4	0.40
14/4	0.42
18/4	0.45
Respironics ComfortFull 2 mask (inspiratory/expiratory positive airway pressure, cmH_2O)*	
10/4	0.65
14/4	0.65
18/4	0.85
Respironics Image 3 mask plus whisper swivel exhalation valve (inspiratory/expiratory positive airway pressure, cmH_2O)*	
10/4	0.95
14/4	0.95
18/4	>0.95
Simple oxygen mask (oxygen flow, L/min)*	
4	0.20
6	0.22
8	0.30
10	0.40, >0.4 during coughing
Jet nebuliser (driven by air at 6 L/min)	
Normal lung	0.45
Mild lung injury	0.54
Severe lung injury	>0.80
Nasal cannula (oxygen flow, L/min)*	
1	0.30
1	0.25 (deflected upward when using electric blanket to mimic fever)
3	0.36
5	0.42
Venturi oxygen mask	
Normal lung	
24% oxygen	0.4
40% oxygen	0.33
Severe lung injury	
24% oxygen	0.32
40% oxygen	0.29
Non-rebreathing oxygen mask (oxygen flow, L/min)	
6, 8, 10, and 12	<0.1

Hong Kong Med J 2014;20(Suppl 4):S9-13

Oxygen therapy in COVID-19 patients

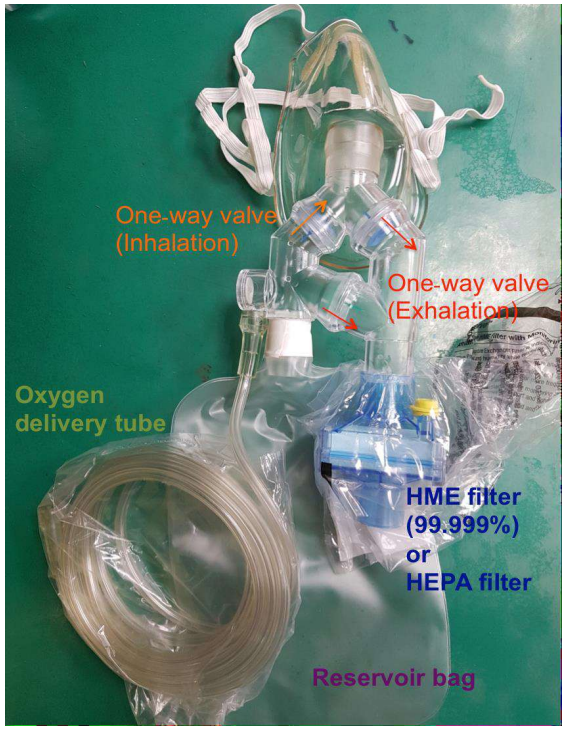
- ✓ nasal cannula with mask
  1) Initial 5L/min (SpO2≥93%)
  2) ≤ 4L/min with target SpO2 ≥93% to minimize complication
  3) With surgical mask

Oxygen therapy in COVID-19 patients

- ✓ avoid masks with side vents or generate aerosols
- ✓Non-rebreathing mask(NRM) with filter
  1) FiO2 range 0.6-0.8
  2) A one-way valve and filter must be used in the expiratory port
  3) The mask should be well fitted

Oxygen therapy in COVID-19 patients

- ✓ High oxygen (Hi-Ox) mask with filter
  1) Initial flow 5-6 L/min
  2) Distress →high flow 10-12L/min
  3) FiO2>80% with flow of 8L/min



Early intubation

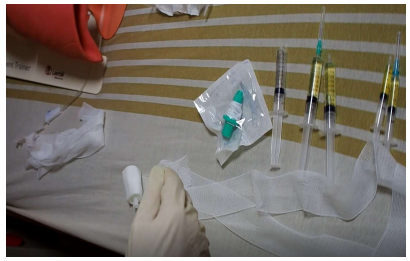
- Rapid progression over hours
- Lack of improvement on >50 L/minute of high flow oxygen and a fraction of inspired oxygen (FiO_2) >0.6
- Evolving hypercapnia, increasing work of breathing, increasing tidal volume, worsening mental status
- Hemodynamic instability or multiorgan failure

Rapid Sequence of Intubation (RSI)

- **RSI steps (seven P's)**
  - ✓ **Preparation**
  - ✓ **Preoxygenation**
  - ✓ **Pre-intubation optimization**
  - ✓ **Paralysis with induction**
  - ✓ **Protection of patient and staff**
  - ✓ **Placement (intubation)**
  - ✓ **Post-intubation management**

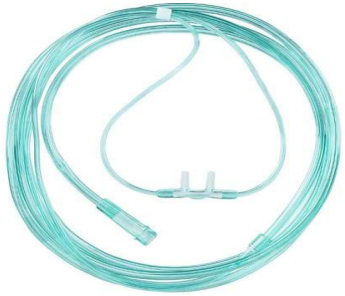
Preparation

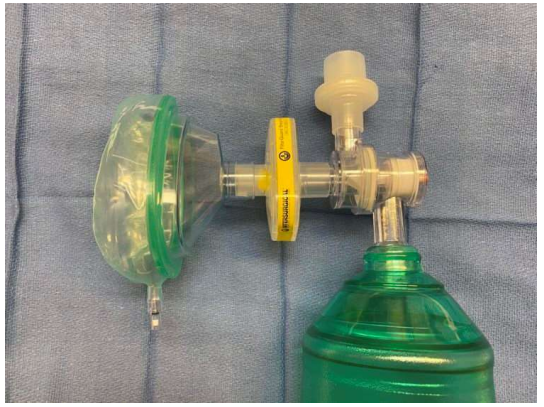
- Prepare all required equipment and draw up and label all medications before entering intubation room.
- Have available all standard airway equipment plus:
  - Bag-mask **with HEPA filter**
  - Video laryngoscope with clear, disposable cover for the device
  - Ventilator and tubing **with in-line adaptors** (for suctioning and bronchoscopy) and **HEPA filters**
  - Waveform capnography if available
  - Smooth clamp for ETT


Preoxygenation

- Bed-up, head elevation position improves preoxygenation.
- for 3 to 5 minutes with 100% O_2 using NRM 15lpm and NC 15lpm
- If BVM must be performed, BVM 15lpm with PEEP valve, connected with HEPA filter
- Avoid any manual ventilation





Paralysis with induction

Induction agents

	Dose	Onset	Duration	Advantage	Disadvantage
Etomidate (20mg/10mL/amp) (163 元/amp)	IV: 0.3 mg/kg (0.2-0.6 mg/kg)	10-20s	4-10 min	● Minimal CV Effects ● ICP↓with minimal effects on cerebral perfusion	● No analgesia ● Myoclonic jerks ● Transient↓cortisol (<24 hrs, beware in sepsis)
Ketamine (500mg/10mL/vial) (400 元/vial)	IV: 1-2 mg/kg IM: 4-10 mg/kg	IV: <30s IM: 3-4min	IV: 5-15 min IM: 12-25 min	● Amnestic and analgesic effects ● Catecholamine reuptake inhibition (blood pressure and heart rate↑, beware in heart disease) ● Bronchodilation	● Emergence delirium, nightmares, and hallucinations
Midazolam (5mg/mL/amp) (25 元/amp)	IV: 0.5-2mg initially, repeated dose every 2-3 mins, usual dose:2.5-5mg IM: 0.07-0.08 mg/kg (usual dose 5mg)	IV:1.5-2.5 min IM~15 min	IV: 30-80 min IM: 6 hr	-	● No analgesia ● Slower onset and longer duration ● Dose-dependent respiratory depression and hypotension
Propofol (200mg/20mL/amp) (56 元/amp)	IV: 0.5-1.5 mg/kg	15-45s	3-10 min	● ↓ICP, may also↓CPP ● Mild bronchodilating effects ● Drug of choice in pregnancy	● No analgesia ● Hypotension and bradycardia ● Negative inotropic effects

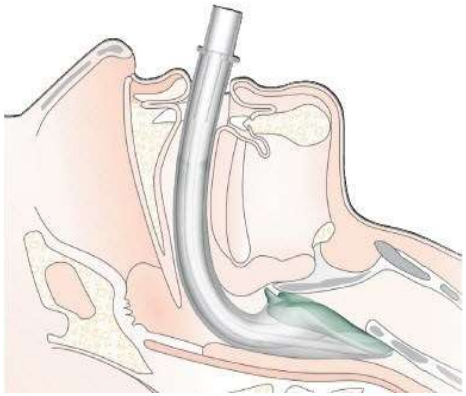
Neuromuscular blocking agents

	Dose	Onset	Duration	Advantage	Disadvantage
Succinylcholine (500mg/vial)	IV: 1-2 mg/kg (For MG: 2mg/kg) IM: 3-4 mg/kg (max. 150mg)	IV:1 min IM: 2-3 min	IV: 4-6 min IM: 10-30 min	● Short duration ● Store in room temperature	● No antidote ● Avoid use in: - Malignant hyperthermia history - Muscular dystrophy - Stroke, Burn > 72hrs - Rhabdomyolysis - Hyperkalemia
Rocuronium (50mg/5mL/vial) (275 元/vial)	IV: 0.6-1.2 mg/kg For MG: 0.6mg/kg	1-2 min	30-60 min	● No significant contraindication ● Antidote: Sugammadex	● Longer duration ● Store in fridge

Placement (intubation)

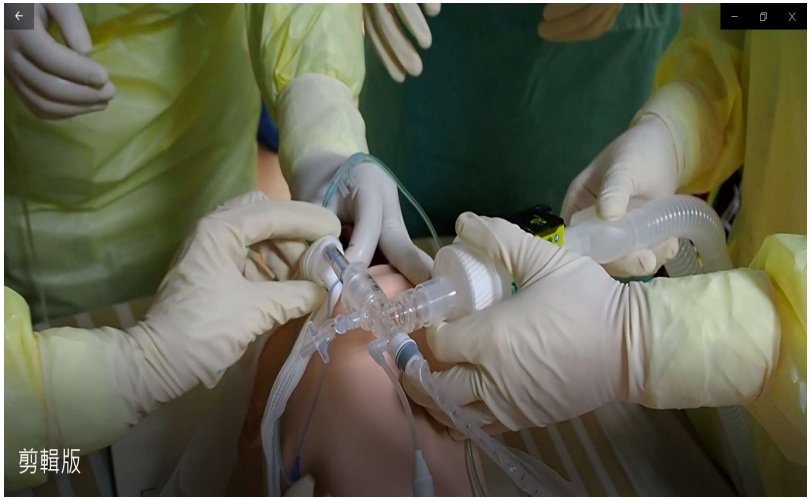
- Use video laryngoscopy
- apneic oxygenation of NC 15 lpm
- If failed intubation, insert supraglottic airway (laryngeal mask, LMA)

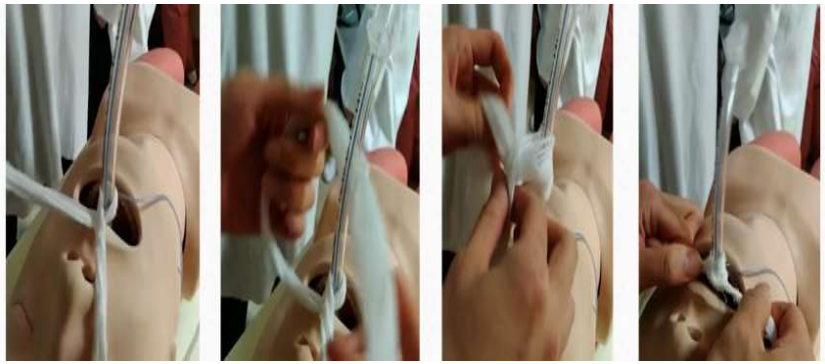
  with pre-set lower pressure (<20 cmH2O) pressure control ventilation



Post-intubation management

- Use ETCO2 device to confirm placement of the ETT
- Limit ventilator disconnections.
- use ETT and ventilator with in-line adaptors for suctioning





Ventilator strategies in ARDS patients

Lung protective ventilation strategy

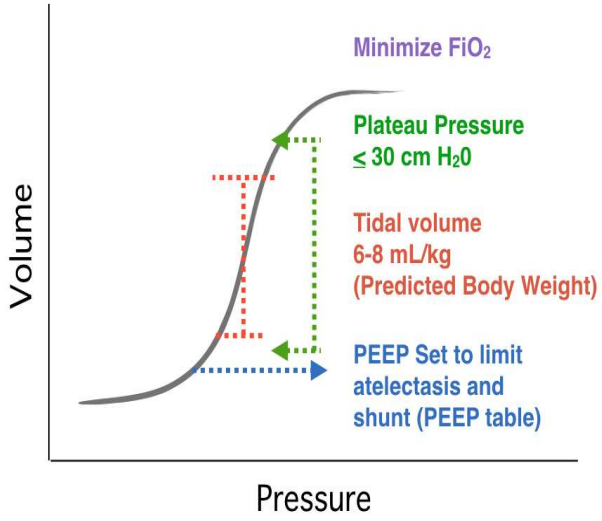
- Low TV (Tidal volume 6ml / Kg predicted body weight)
- Plateau pressure < 30 cmH_2O
- Driving pressure < 15 cmH_2O
- Tolerate hypercapnia if PH > 7.2

Lower PEEP/higher FiO2

FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

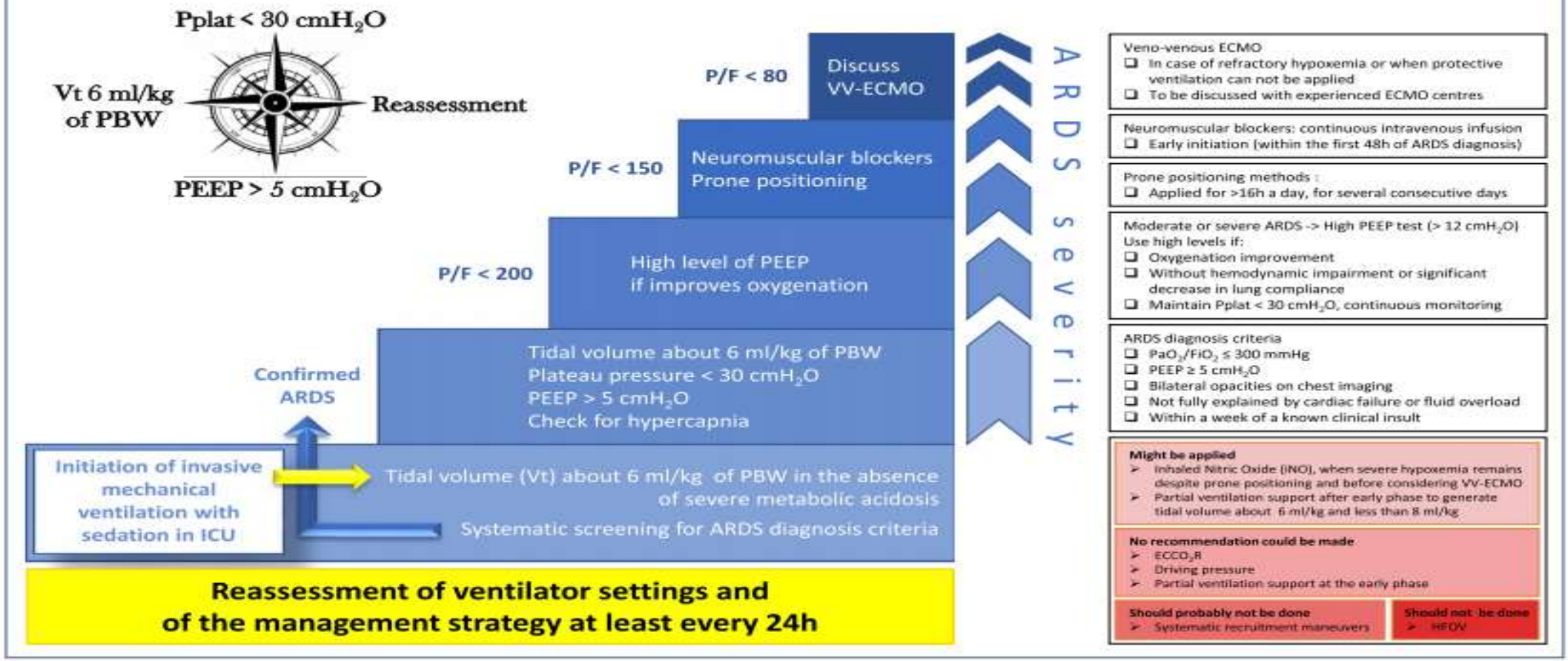
FiO_2	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

NIH NHLBI ARDS Clinical Network



Components of Lung Protective Ventilation to reduce Ventilator-Associated Lung Injury (VALI) and decrease incidence of ARDS

Early management of ARDS in 2019



Weaning

- weaning process
  - suggest using closed systems and not using a T-piece trial for SBTs.
- weaning profile
- cuff leak test

Extubation

- use medications to decrease coughing

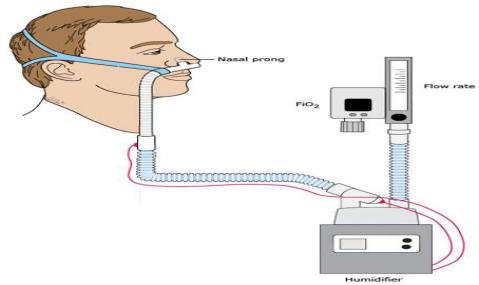
  eg: lidocaine

- put the ventilator in standby mode (or switch off) immediately prior to extubation

- The endotracheal tube should be remove as smoothly

- support the application of supplemental oxygen

High flow nasal cannula



HFNC may increase the risk of viral spread through aerosol generation

Mechanisms and benefits of oxygen delivered via via high flow nasal cannula

Mechanism	Physiologic and clinical benefit
Small, pliable nasal prongs	▪ Enhanced patient comfort
Heat and humidification	▪ Facilitates removal of airway secretions ▪ Avoids airway desiccation and epithelial injury ▪ Decreased work of breathing ▪ Enhances patient comfort
Washout of nasopharyngeal deadspace	▪ Improved ventilation and oxygen delivery
Positive end-expiratory (PEEP) effect	▪ Unload auto-PEEP (if present) ▪ Decrease work of breathing ▪ Enhance oxygenation
High nasal flow rate	▪ Reliable delivery of fraction of inspired oxygen (FiO_2) ▪ Improved breathing pattern (eg, increased tidal volume, decreased respiratory rate)

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PMCID: PMC7163690
PMID: 32299867

High-flow nasal cannula for COVID-19 patients: low risk of bio-aerosol dispersion

Jie Li,[1] James B. Fink,[1] and Stephan Ehrmann[2]

Bio-aerosol dispersion *via* high-flow nasal cannula shows a similar risk to standard oxygen masks. High-flow nasal prongs with a surgical mask on the patient's face might benefit hypoxaemic COVID-19 patients without added risk for the environment. https://bit.ly/34p7Fyy

Exhaled air dispersion during high-flow nasal cannula therapy *versus* CPAP *via* different masks

TABLE 2 Exhaled air dispersion with 20% normalised smoke concentration during application of high-flow nasal cannula at 37°C under different severity of lung injury

Scenario	Lung condition/injury	Flow rate L·min^{-1}	Exhaled air dispersion distance mm
1	Normal	60	172±33
2	Mild	60	72±18
3	Severe	60	48±16
4	Normal	30	130±11
5	Mild	30	61±17
6	Severe	30	37±12
7	Normal	10	65±15
8	Mild	10	43±10
9	Severe	10	30±8

Data are presented as n or mean±SD.

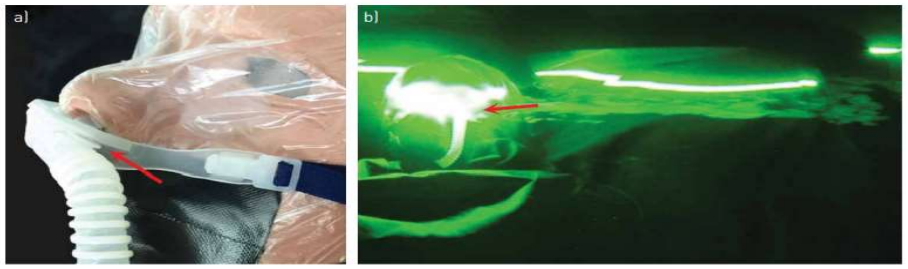


FIGURE 3 a) A loose connection (arrow) between the high-flow nasal cannula (60 L·min^{-1}) and the interface tube. b) This resulted in exhaled air leakage to 620 mm laterally.

Surgical mask on top of high-flow nasal cannula improves oxygenation in critically ill COVID-19 patients with hypoxemic respiratory failure

Virginie Montiel[1*], Arnaud Robert[1], Annie Robert[2], Anas Nabaoui[1], Tourneux Marie[1], Natalia Morales Mestre[1,3], Maerckx Guillaume[1,3], Pierre-François Laterre[1] and Xavier Wittebole[1]

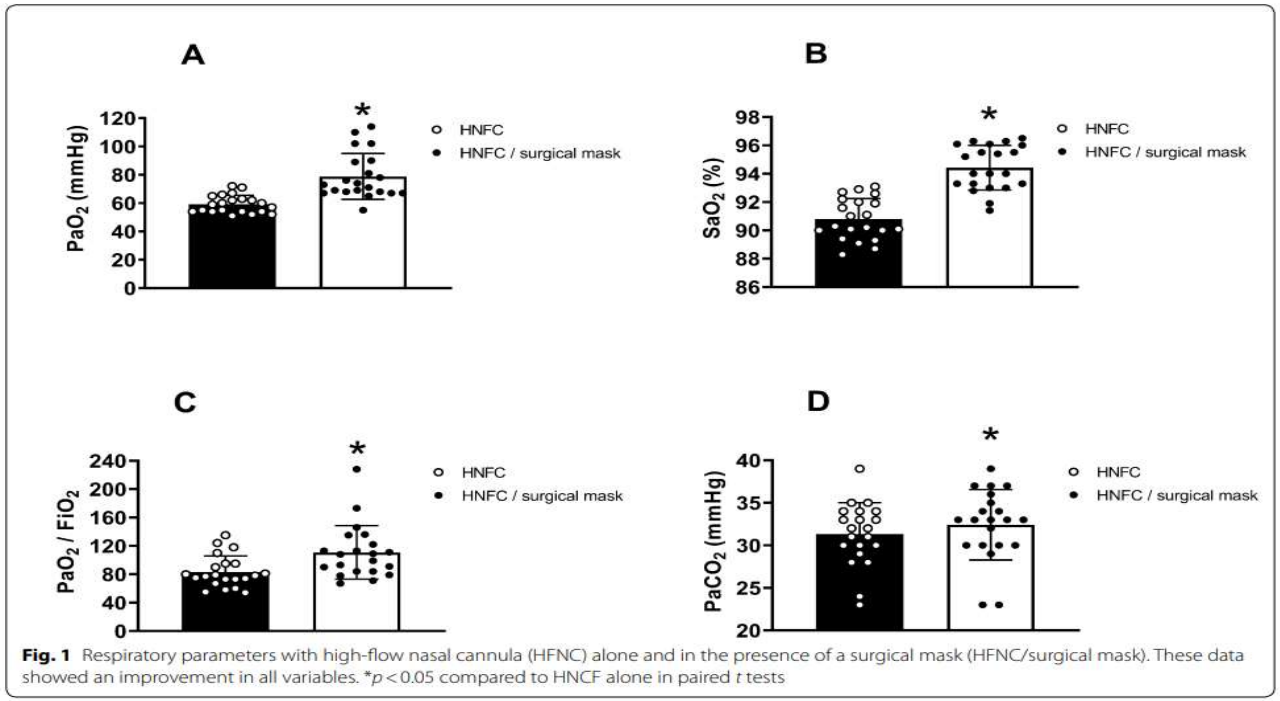
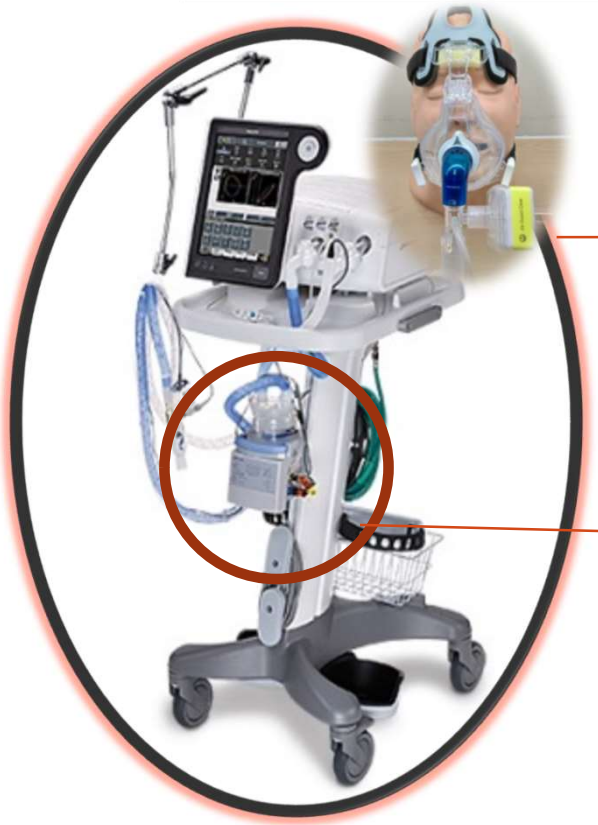


Fig. 1 Respiratory parameters with high-flow nasal cannula (HFNC) alone and in the presence of a surgical mask (HFNC/surgical mask). These data showed an improvement in all variables. *$p < 0.05$ compared to HNCF alone in paired *t* tests

Non-invasive ventilation (NIV)



- Aerosol-generating device
- Leakage
- Higher inspiratory pressure

Heat and moisture exchanger filter

① Dead space decreases carbon elimination

② Blockage by moist secretions

Heated humidity

➢ Generate aerosol and facilitate viral spread

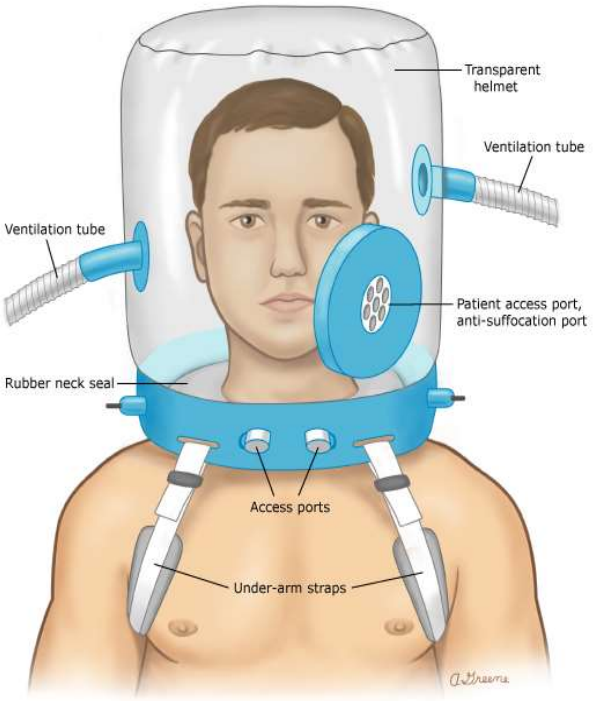
✓ Ventilator equipped with no port mask, 2-tube, closed circuit system plus viral filter may be acceptable

✓ Must be operated in a negative pressure room and PPE must be correctly donned.

✓ Prepare for early intubation if clinical condition fails to improve within one hour.

UpToDate®

Helmet - NIV



1) to improve patients' comfort
   - ➢ speech and feeding and not limiting cough
   - ➢ skin necrosis, gastric distension or eye irritation are seldom

2) helmets permit longer-term treatments and allow the setting of higher levels of PEEP
   - ➢ without causing air leaks or important patient-ventilator asynchrony

呼吸治療設備與呼吸器管路的消毒

- 所有呼吸治療相關用物，應儘可能使用可拋棄式，包括氧氣治療用物、 呼吸器管路、甦醒球等等。
- 單次使用的醫材設備應丟棄於病室內的醫療廢棄物垃圾桶。
- 研究顯示病毒可能存在於金屬、玻璃或塑膠物體表面長達數天，需確實有效的消毒，預防病毒傳播。
- 可使用 75%酒精擦拭呼吸器螢幕。
- 呼吸器機身使用高濃度稀釋漂白水擦拭；也可依據製造商產 品說明書或各醫院訂立之感控標準操作所提供的消毒方法嚴格執行。頻率每日至少一次，可依髒污程度增加次數。
- 紫外線 (UV)主要對環境消毒效果，對呼吸器消毒沒有太多文獻證實， 無法全面殺菌，因此不建議單獨使用於呼吸器消毒。
- 病人卸機後之終期消毒，先於負壓病室內以紫外燈直接照射消毒2小時，再進一步將單拋式呼吸管、氧氣治療、甦醒球等物品，丟棄於病室 內的醫療廢棄物垃圾桶，再依上述每日消毒之方法執行完整消毒。

Thank you for attention