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**Evidence for awake prone positioning in patients with COVID-19
- A rapid review of the evidence**

Lucy E. Kirk
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ANU College of Health and Medicine COVID-19 Evidence Team

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Correspondence to:

Lucy E. Kirk

CHS COVID19 Research Assistant (Evidence)
Australian National University Medical School

M: +61 405 841 579

E: lucy.kirk@anu.edu.au

COVID19 Canberra Health Service and ANU College of Health and Medicine – Awake prone positioning

6/4/20, L KIRK

Acronyms:

- WHO: World Health Organization, CDNA: Communicable Diseases Network Australia, PPE: Personal protective equipment, HCW: Healthcare worker, IMV: invasive mechanical ventilation, NIV: non-invasive ventilation, HFNC: high-flow nasal cannula, PP: prone position

Summary:

- Prone positioning has known benefits in intubated patients with ARDS (evidence not presented here)
- **Is prone positioning effective?**
 - o **Overall, YES**, however, the effect is variable and not always sustained → in some patients it may just delay intubation, others it may prevent
 - A recent cohort study of 20 patients with ARDS, showed that PP used with HFNC or NIV and **may increase PaO₂/FiO₂ by 25-35 mmHg**
 - A study of 15 patients with acute respiratory failure showed oxygenation was significantly improved during proning
 - In COVID19 patients, reports from China (and one from the UK) suggest awake prone positioning significantly improves oxygenation
 - A study of lung recruitability in COVID19 patients showed a significant increase in recruitability in a prone position compared to supine
- **Should we be using awake prone positioning in patients with COVID19?**
 - o Consider the predicted clinical course of the patient – **most appropriate in mild and moderate patients to prevent or delay intubation**
 - Severe ARDS do not appear appropriate for awake prone positioning → **Should not delay intubation in a patient that requires it**
 - **In the case of a resource shortage, it may be an effective strategy in the hope that you may prevent, or delay the need for intubation**
 - o May be most appropriate in patients that have:
 - Isolated hypoxaemic respiratory failure, without substantial dyspnoea (“well appearing” but hypoxaemic)
 - Not in multi-organ failure
 - No significant hypercapnia or dyspnoea
 - Normal mental status
 - No anticipation of a difficult airway
- **Any recommended strategies?**
 - o **For as long as tolerated, as often as tolerated** (Chinese handbook - 4hrs multiple times per day, cohort study – 30min minimum twice daily)
 - Ensure lines are adequately secured and continuous monitoring is in place
 - Use well positioned pillows to improve compliance
 - Consider gastric residual volume to reduce risk of aspiration

EVIDENCE BASE AND SOURCE**Guideline: *Handbook of COVID-19 prevention and treatment*¹**

This is the “big” handbook produced by The First Affiliated Hospital, Zhejiang University School of Medicine

SUMMARY – RELATING TO AWAKE PRONE POSITIONING OF PATIENTS WITH COVID-19

- Does not provide evidence, just recommendations on their experience from treating
- “Most critically ill patients with COVID-19 respond well to prone ventilation...”
- For intubated patients, ≥16hrs each session is recommended as a routine strategy for patients with:
 - o PaO₂/FiO₂ < 150mgHg OR
 - o Obvious imaging manifestations without any contraindications
- Prone positioning can be ceased when PaO₂/FiO₂ > 150mgHg for more than 4hrs in a supine position
- Awake prone ventilation may be attempted for those who do not yet have respiratory distress or are intubated but have:
 - o **Impaired oxygenation**
 - o **Consolidation in dependent lung zones on imaging**
- For awake prone positioning, **aim for 4hrs per session, multiple times per day as tolerated** and shown efficacy

28/03/20, Guideline: ***Surviving Sepsis Campaign: guidelines on the management of critically ill adults with COVID-19***

<https://link.springer.com/article/10.1007/s00134-020-06022-5>

- No discussion of awake prone positioning
- “For mechanically ventilated adults w/ COVID-19 and **moderate to severe ARDS**, we suggest **prone ventilation for 12-16 hrs**” (weak recommendation, low quality evidence)
- Image findings are showing some patients have a mixed pattern of predominant basilar consolidation
 - o Role of prone ventilation due to known effects of prone ventilation on ARDS → reduced mortality if >12hrs
- Clinicians must have knowledge of complications such as pressure sores, vascular access and ETT displacement, facial oedema, transient haemodynamic instability, corneal abrasions, brachial plexus injury, and vascular access occlusion.
- Absolute contraindications include:
 - o Unstable spine
 - o Open abdomen
 - o Open chest

16/03/20, Guideline: ***The ANZICS COVID-19 Guidelines (Version 1)***

<https://www.anzics.com.au/coronavirus-guidelines/>

- No discussion of awake prone positioning
- “Current reports suggest prone ventilation is effective in improving hypoxia associated with COVID-19. This should be done in the context of a hospital guideline that includes **suitable PPE for staff**, and **minimises the risk of adverse events.**”

13/03/20, Guideline: ***Clinical management of severe acute respiratory infection (SARI) when COVID19 disease is suspected*²**

<https://www.who.int/docs/default-source/coronaviruse/clinical-management-of-novel-cov.pdf>

- No discussion of awake prone positioning
- Recommends 12-16hrs/day of prone ventilation in adults with severe ARDS
- Reminds that it requires sufficient human resources and expertise to be performed safely

18/03/20, Letter: **Lower mortality of COVID-19 by early recognition and intervention: experience from Jiangsu Province³**

<https://doi.org/10.1186/s13613-020-00650-2>

- Letter of summary of critical care management of COVID-19 patients in Jiangsu (where mortality was lower than in Hubei)
- 1. Early recognition of high risk and critically ill patients
 - o All patients were screened twice daily for: RR, HR, SpO₂ on RA
 - o If SpO₂ <93%, RR>30/min, HR>120/min, or any signs of organ failure, patient would be transferred to ICU
 - o Age, WCC, O₂ supplementation, radiographic evidence of pulmonary infiltrations were risk factors for progression to critical care. → established early warning system to determine risk level of patients
- 2. Early intervention guided by intensivists
 - o **If ARDS or extensive effusion on CT, use of HFNC or NIV was used to maintain PEEP, even if patients did not have refractory hypoxaemia**
 - o Use of restricted fluid resuscitation
 - o **Awake prone positioning which appeared to significantly improve oxygenation**
 - **Rate of critically ill patients ~10%, but invasive ventilation was <1% of patients**
- 3. Clinical experts-guided hierarchical management strategy
 - o Panel of primarily critical care and respiratory specialists
- 4. Rational allocation of materials and human resources
 - o Resources, including medical staff and PPE were mobilised and deployed for patients care
 - o 234 clinical staff for COVID19 patients, with 3500 extra for surge capacity

23/03/20, Research article: **Lung recruitability in SARS-CoV-2 associated acute respiratory distress syndrome: a single-center, observational study⁴**

<https://www.atsjournals.org/doi/abs/10.1164/rccm.202003-0527LE>

- Study aimed to determine if lungs are recruitable with high PEEP in patients with ARDS due to COVID19
- Recently, group described an index to quantify patient potential for lung recruitment (recruitment-to-inflation ratio, R:I)
 - o Estimates how an increase in end-expiratory lung volume is distributed between newly recruited lung, and hyperinflation of already inflated lung
 - o Ranges from 0 to 2.0 → higher value suggests higher likelihood of recruitment
 - I.e. R:I of 1.0 suggests increased volume from increased PEEP to be distributed between already inflated lung, and newly recruited lung
 - o R:I could be used to measure recruitment in patients with COVID19, and assess the effect of body positioning
- Was a retrospective observational study of 12 patients with SARS-CoV-2 admitted to ICU, and receiving IMV
- Seven patients received at least one session of prone positioning
 - o Alternating between prone and supine positioning was associated with increased lung recruitability (stat. sig)
 - Also had increased PaO₂/FiO₂ when prone, but not stat. sig (P=0.065)
- Majority of patients had poorly recruitable lung with high PEEP, but recruitability changed with prone positioning

05/04/20, Personal communication:
COVID19 Communication for the UK⁵

- Letter from a Professor of Anaesthesia, Intensive Care Lead of High. Consequence Infectious Disease at the Royal Free Hospital, London → The letter contained information regarding ventilation, fluid balance, renal function, and workforce planning → only information regarding PRONE POSITIONING is summarised here
- **“Proning is essential and should be done early”** → threshold in many centres is PF ratio of 13, but it is agreed it should occur earlier
 - In early stages of disease, the benefit lasts < 4hrs when returned to supine, but as disease progression occurs, the effect of proning appears to be more long lasting
 - **“Proning patients on CPAP on the ward is very effective, I tried it the other day – worked wonders.”**

30/03/20, Letter: **COVID-19 does not lead to a “typical” acute respiratory distress syndrome⁶**

<https://www.atsjournals.org/doi/abs/10.1164/rccm.202003-0817LE>

- Letter reporting on experience of disease progression of COVID19 patients in Italy
- “... patients with COVID-19 pneumonia, fulfilling the Berlin criteria of ARDS, present an atypical form of the syndrome”
- Have found that there is a dissociation between relatively “well preserved” lung mechanics and severity of hypoxaemia
 - Have relatively high compliance indicating well preserved lung gas volume, in contrast to expectation for ARDS
- Thought to be explained by a loss of lung perfusion regulation and loss of hypoxic vasoconstriction
 - PQ showed hyperperfusion of gasless lung tissue
- Based on this, need to consider:
 - If treated with CPAP or NIV and are presenting with excessive inspiratory effort, intubation should be prioritised to avoid excessive intrathoracic negative pressures
 - High PEEP in a poorly recruitable lung leads to severe haemodynamic impairment and fluid retention
 - Prone positioning can lead to modest benefit at the cost of high demand for already stressed and stretched human resources
- **Buy time with minimal additional damage, the lowest possible PEEP and gentle ventilation... be patient**

31/03/20, Blog post: **COVID-19 Hypoxemia: A better and still safe way⁷**

<https://rebelem.com/covid-19-hypoxemia-a-better-and-still-safe-way/>

- Blog post discusses range of issues, including distance travelled of aerosolised particles using HFNC and NIV
- Reports that although disease process has been categorised like ARDS, it is not necessarily ARDS
 - Often have normal lung compliance and often not in respiratory distress despite low SpO₂
 - SpO₂ may not correlate with symptoms
 - HOWEVER, there are patients presenting more traditionally with Sx matching SpO₂
- Target SpO₂ 88-92% with FiO₂ ≤0.6
 - If not, consider use of HFNC + PP, or then NIV + PP

11/03/20, Clinical update: **Care for critically ill patients with COVID-19⁸**

<https://jamanetwork.com/journals/jama/article-abstract/2762996>

- Summary letter on critical care of COVID19 patients – I have briefly summarised here but it provides a good overview
- Patients requiring critical care tended to be: older, have comorbidities (commonly diabetes and cardiac disease)
- Med duration between onset of symptoms and ICU admission has been 9 to 10 days
- 2/3 patients meet criteria for ARDS
- Evidence-based treatment for ARDS should be followed, including prone positioning
- Septic shock and AKI are occurring in a significant proportion of patients and should be treated according to guidelines

NON-COVID19

30/01/20, Research article: **Efficacy and safety of early prone positioning combined with HFNC or NIV in moderate to severe ARDS: a multi-center prospective cohort study**⁹

<https://ccforum.biomedcentral.com/articles/10.1186/s13054-020-2738-5#citeas>

- 20 enrolled patients with ARDS → 10 cases moderate, 10 cases severe
 - o Excluded if: signs of respiratory failure, immediate need for intubation, haemodynamically unstable, inability to cooperate
 - o Prone position for at least 30min twice daily, HFNC or NIV were provided as needed
 - o Levels of care: HFNC → HFNC + PP → NIV → NIV + PP
- 11 avoided intubation (success), 9 required intubation (failure – PaO₂/FiO₂ <100mmHg on NIV+PP) → 3 to ECMO, 1 death
 - o Average duration of prone positioning was 2hr BD
 - o Two patients could not tolerate the PP
 - o In “success” patients, pre-PP SpO₂ was significantly higher (95% +/- 1% vs. 93% +/- 3% in “failed” patients)
 - o Early PP combined with HFNC/NIV may avoid the need for intubation in up to half of patients
 - o When PP was added to use of HFNC or NIV, PaO₂/FiO₂ increased by 25-35 mmHg
- In patients with moderate ARDS and baseline SpO₂ >95%, prone positioning and HFNC may help avoid intubation
- Severe ARDS patients do not appear to be appropriate candidates for HFNC/NIV + PP as it risks delaying intubation

NON-COVID19

16/07/15, Research article: **Prone positioning improves oxygenation in spontaneously breathing nonintubated patients with hypoxemic acute respiratory failure: A retrospective study**¹⁰

<https://www.sciencedirect.com/science/article/abs/pii/S0883944115003755?via%3Dihub>

- *Article evaluating the efficacy of prone positioning in awake, non-intubated patients with hypoxemic acute respiratory failure – evaluated 15 non-intubated patients with 43 episodes of prone-positioning*
- **Prone positioning significantly improved oxygenation during prone positioning**
 - o Oxygenation was not sustained at 8hrs post → may not have caused stable recruitment of dorsal lung regions
- Only two episodes of prone positioning were interrupted due to patient intolerance
- No complications of proning were recorded, prone positioning did not alter RR or haemodynamics
- Awake prone positioning is effective in increasing patient oxygenation during prone positioning
 - o This may be a tool for delaying, or preventing invasive mechanical ventilation, and decrease VAP
- Things to consider before proning an awake patient:
 - o In a cooperative patient → two nurses and an attending doctor, but if impaired mobility → five staff
 - o Evaluate gastric residual volume to reduce risk of aspirations
 - o Ensure appropriate skin protections on pressure points to avoid pressure sores
 - o Careful application of cushions will improve patient tolerance
- This study did NOT evaluate the ideal duration or frequency of prone positioning (but med. 3hrs, max. 8hrs)

NON-COVID19

10/04/03, Research article: **Response to the prone position in spontaneously breathing patients with hypoxaemic respiratory failure**¹¹

<https://onlinelibrary.wiley.com/doi/epdf/10.1034/j.1399-6576.2003.00088.x>

- *Case series review of four cases of hypoxemic respiratory failure where prone positioning was performed*
- In all four cases, mechanical ventilation was indicated, but was averted by prone positioning and its effect on the clinical condition and changes in blood gases
 - o Length of prone positioning: 2hrs, 4hrs, ?, 5hrs
 - o In all the presented cases, patients only had one episode of prone positioning
 - o All cases showed evidence of sustained improved lung function
- Prone positioning had high patient tolerance and no significant complications were caused

NON-COVID19

21/09/16, Blog post: **PulmCrit Wee –
Prone the non-intubated patient**¹²

<https://emcrit.org/pulmcrit/prone-nonintubated/>

- *Blog post that references some of the articles above, but provides some other helpful thoughts*
- Discusses main risk is that it delays intubation in a patient that deteriorates further and becomes increasingly hypoxaemic
 - o Therefore close monitoring with prompt intubation should occur as appropriate
- Consider overall patient trajectory: Some cases may avert the need for intubation
 - o Other cases may have a progressive decline and require intubation → delaying intubation is then pointless
- Candidates for awake prone may be:
 - o Isolated hypoxaemic respiratory failure, without substantial dyspnoea (“well appearing” but hypoxaemic)
 - o Not in multi-organ failure
 - o Expectation of reversible lung injury that may avoid intubation
 - o No significant hypercapnia or dyspnoea
 - o Normal mental status
 - o No anticipation of a difficult airway
- HOWEVER (importantly for COVID19)... → prone positioning in an awake patient could act as a temporary measure if intubation isn't immediately available → ie. During transport

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