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

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COVID19 Canberra Health Service and ANU College of Health and Medicine – Awake prone positioning
6/4/20, L KIRK

Acronyms:

Summary:
- Prone positioning has known benefits in intubated patients with ARDS (evidence not presented here)
- **Is prone positioning effective?**
  - **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?**
  - 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
  - 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?**
  - **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
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<th>EVIDENCE BASE AND SOURCE</th>
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| **Guideline: Handbook of COVID-19 prevention and treatment**<sup>1</sup> | - 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:  
  - PaO2/FiO2 < 150mgHg OR  
  - 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:  
  - Impaired oxygenation  
  - 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<sup>2</sup> | - 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  
  - 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:  
  - Unstable spine  
  - Open abdomen  
  - Open chest |
| 16/03/20, Guideline: The ANZICS COVID-19 Guidelines (Version 1) | - 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<sup>2</sup> | - 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 Province


- *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
    - All patients were screened twice daily for: RR, HR, SpO2 on RA
    - If SpO2 <93%, RR>30/min, HR>120/min, or any signs of organ failure, patient would be transferred to ICU
    - 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
    - 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
    - Use of restricted fluid resuscitation
    - *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
    - Panel of primarily critical care and respiratory specialists
  - 4. Rational allocation of materials and human resources
    - Resources, including medical staff and PPE were mobilised and deployed for patients care
    - 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 study


- *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)
    - Estimates how an increase in end-expiratory lung volume is distributed between newly recruited lung, and hyperinflation of already inflated lung
    - Ranges from 0 to 2.0 → higher value suggests higher likelihood of recruitment
      - Ie. R:I of 1.0 suggests increased volume from increased PEEP to be distributed between already inflated lung, and newly recruited lung
    - 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
    - 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
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| 05/04/20   | **Personal communication:** COVID19 Communication for the UK**                               | 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 syndrome**        | 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 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-19**                          | 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  |

**COVID-19**: awake proning

**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 multicenter prospective cohort study*⁹

- 20 enrolled patients with ARDS → 10 cases moderate, 10 cases severe
  - Excluded if: signs of respiratory failure, immediate need for intubation, haemodynamically unstable, inability to cooperate
  - Prone position for at least 30min twice daily, HFNC or NIV were provided as needed
  - 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
  - Average duration of prone positioning was 2hr BD
  - Two patients could not tolerate the PP
  - In “success” patients, pre-PP SpO2 was significantly higher (95% +/- 1% vs. 93% +/- 3% in “failed” patients)
  - Early PP combined with HFNC/NIV may avoid the need for intubation in up to half of patients
  - 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 non-intubated patients with hypoxemic acute respiratory failure: A retrospective study*¹⁰

- 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
    - 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
      - This may be a tool for delaying, or preventing invasive mechanical ventilation, and decrease VAP
    - Things to consider before proning an awake patient:
      - In a cooperative patient → two nurses and an attending doctor, but if impaired mobility → five staff
      - Evaluate gastric residual volume to reduce risk of aspirations
      - Ensure appropriate skin protections on pressure points to avoid pressure sores
      - 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

- 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
    - Length of prone positioning: 2hrs, 4hrs, ?, 5hrs
    - In all the presented cases, patients only had one episode of prone positioning
    - All cases showed evidence of sustained improved lung function
  - Prone positioning had high patient tolerance and no significant complications were caused
- 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
  - Therefore close monitoring with prompt intubation should occur as appropriate
- Consider overall patient trajectory: Some cases may avert the need for intubation
  - Other cases may have a progressive decline and require intubation → delaying intubation is then pointless
- Candidates for awake proning may be:
  - Isolated hypoxaemic respiratory failure, without substantial dyspnoea (“well appearing” but hypoxaemic)
  - Not in multi-organ failure
  - Expectation of reversible lung injury that may avoid intubation
  - No significant hypercapnia or dyspnoea
  - Normal mental status
  - No anticipation of a difficult airway
- HOWEVER (importantly for COVID19)... → prone positiong in an awake patient could act as a temporary measure if intubation isn’t immediately available → ie. During transport
REFERENCE LIST