ClinicalEvidence

Respiratory disorders (acute)

Acute respiratory distress syndrome

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Effects of interventions in adults with ARDS

Prone position

In this section:

Summary

Prone position can improve oxygenation, but this benefit must be carefully weighed against the lack of any good evidence of benefit or mortality, and uncommon but potentially serious harms. One systematic review found that prone positioning improved oxygenation in 69% of people with acute respiratory distress syndrome. However, the review and one subsequent RCT found no difference in mortality at 10 days and at 6 months between supine and prone positioning. One small controlled clinical trial found that both prone positioning and positive end expiratory pressure improved oxygenation compared with supine positioning alone. Subgroup analysis found that only prone positioning improved oxygenation in those with localised infiltrates, compared with supine positioning or positive end expiratory pressure. Adverse effects of prone positioning include increased sedation, facial oedema, and accidental extubation. Spinal instability is an absolute contraindication to prone positioning. Relative contraindications include haemodynamic and cardiac instability, and recent thoracic or abdominal surgery.

Benefits

Prone position versus supine position:

We found one systematic review, [38] two subsequent RCTs, [39] [40] and one randomised prospective trial. [41] The systematic review (search date 1998, 297 people, 14 prospective cohort studies, 3 RCTs) compared prone positioning with usual care in the supine position. [38] The systematic review did not report the RCT data separately. It noted that the timing from the onset of respiratory failure to when participants were first positioned prone, and the frequency of the prone position, varied between studies (length of time in prone position: 30 minutes to 42 hours). It found that 148/213 (69.5%) of people had an improved ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen (PaO_2/FiO_2) ratio of more than 20 mm Hg, or 20% of the baseline within 2 hours, when moved from supine to prone. However, it found no significant difference between supine and prone positioning in mortality (figures not reported; significance assessment not performed). The first subsequent RCT (304 people, 94% with acute respiratory distress syndrome [ARDS] and 6% with acute lung injury [ALI]) compared prone position with supine position. [39] It found no significant difference between prone position and supine position in mortality at 10 days, at time of discharge from the intensive care unit, or at 6 months (mortality at 10 days: 32/152 [21.1%] with prone position *v* 38/152 [25.0%] with supine position; RR 0.84, 95% CI 0.56 to 1.27; mortality at intensive care unit discharge: 77/152 [50.7%] with prone position *v* 73/152 [48.0%] with supine position; RR 1.05, 95% CI 0.84 to 1.32; mortality at 6 months: 95/152 [62.5%] with prone position *v* 89/152 [58.6%] with supine position; RR 1.06, 95% CI 0.88 to 1.28). The second subsequent RCT (130 people with ARDS, ALI, or respiratory failure) compared supine position ventilation with prone position ventilation (continuous prone ventilation treatment for 20 hours/day). The RCT found no

significant difference in intensive care mortality with supine position ventilation compared with prone position ventilation (35/60 [58%] with supine position *v* 37/76 [43%] with prone position; P = 0.12). [40] The prone position for ventilation had a higher Simplified Acute Physiology Score II at inclusion. Multivariate analysis found that Simplified Acute Physiology Score II at inclusion (OR 1.07, CI not reported; P < 0.001), number of days elapsed between ARDS diagnosis and inclusion (OR 2.83, CI not reported; P < 0.001), and randomisation to supine position (OR 2.53, CI not reported; P = 0.03) were independent risk factors for mortality. [40] The prospective randomised trial (40 people with ALI or ARDS) compared the effect of prone position ventilation (at least 8 hours and a maximum of 23 hours/day) with supine position ventilation on the duration of mechanical ventilation. [41] The study found that the duration of ventilatory support did not differ significantly between groups (30 ± 17 days with prone position *v* 33 ± 23 days with supine position; no significance assessment performed). Death and deterioration of gas exchange were seen (PaO_2/FiO_2 ratio) for 41 ± 29 days with prone position and 61 ± 35 days with supine position (P = 0.06). Oxygenation (PaO_2/FiO_2 ratio) improved significantly over the first 4 days of treatment with the prone position compared with the supine position (P = 0.03). The prevalence of ARDS after ALI (P = 0.03) and of pneumonia (P = 0.048) were also reduced in the prone position compared with the supine position. [41]

Prone position plus positive end expiratory pressure versus supine position plus positive end expiratory pressure:

We found one controlled clinical trial (25 people with ARDS; computed tomography scan used to identify those with localised infiltrates or diffuse infiltrates), which compared the effect on oxygenation of prone position versus supine position in the presence of varying levels of additional positive end expiratory pressure (PEEP). [42] Oxygenation measurements were taken at four PEEP levels (0, 5, 10, and 15 cm H_2O), applied in a random order in both positions. It found that, compared with the supine position, the prone position significantly improved oxygenation, defined as an increased PaO_2/FiO_2 ratio (mean: 86 with supine *v* 152 with prone at zero PEEP; p = 0.002; overall results presented graphically; p < 0.001). PEEP independently improved oxygenation compared with supine positioning (p < 0.001). A subgroup analysis found that, although both PEEP and the prone position significantly improved oxygenation in people with diffuse infiltrates compared with baseline measures (P < 0.001), only the prone position improved oxygenation in people with localised infiltrates (results presented graphically; significance assessment not performed).

Harms

Prone position versus supine position:

Adverse effects are uncommon but potentially serious during prone positioning in people with ARDS. The total number of prone cycles (from supine to prone and back again) in the review was 746. It found that prone positioning was associated with haemodynamic instability, inadvertent extubation, desaturation, endotracheal tube obstruction, dislodgement of a central venous catheter, and dislodgement of a femoral haemodialysis catheter (haemodynamic instability: 8 events, 1.1% per prone cycle; inadvertent extubation: 3 events, 0.4% per prone cycle; desaturation: 2 events, 0.3% per prone cycle; endotracheal tube obstruction: 1 event, 0.1% per prone cycle; dislodgement of central venous catheter: 1 event, 0.1% per prone cycle; dislodgement of femoral haemodialysis catheter: 1 event, 0.1% per prone cycle). Significance assessments were not performed for any of these comparisons. [38] In the subsequent RCT, there was no significant difference between the prone and supine positions in the number of pressure sores, new or worsening pressure sores, tracheal tube displacement, loss of venous access, or displacement of thoracostomy (number of pressure sores: 22.5% with supine position *v* 24.0% with prone position; p = 0.78; new or worsening pressure sores during 10 day study period: 27.5% with supine position *v* 36.0% with prone position; p = 0.13; tracheal tube displacement: 9.9% with supine position *v* 7.9% with prone position; p = 0.68; loss of venous access: 9.2% with supine position *v* 5.3% with prone position; P = 0.27; displacement of a thoracotomy tube: 0.7% with supine position *v* 3.9% with prone position; p = 0.12; absolute figures for all outcomes not reported). [39] Adverse effects associated with prone positioning included an

increased need for sedation and muscle relaxants (55.2%), airways obstruction (39.3%), and facial oedema (29.8%). The second subsequent RCT reported a total of 718 turning cycles. Although a total of 28 complications were reported, most were rapidly reversible. These included oedema (facial, limbs, thorax), conjunctival haemorrhage, pressure sores, and accidental dislodgement of lines and tubes. [40] The prospective trial gave no information on adverse effects. [41]

Prone position plus positive end expiratory pressure versus supine position plus positive end expiratory pressure:

The controlled clinical trial gave no information on adverse effects. [42]

Comment

The first subsequent RCT (162 people) performed a subgroup analysis not originally part of the study design in people with at least one of three high risk characteristics: low Pao_2/Fio_2 ratio, high Simplified Acute Physiology Score, and high tidal volume (79 with supine position and 83 with prone position; 111 with one characteristic and 51 with 2 or 3). [39] It found that, compared with the supine position, prone positioning significantly decreased the proportion of people who had died at 10 days (40.0% with supine position *v* 20.5% with prone position; RR 0.54, 95% CI 0.32 to 0.90). These differences in mortality did not persist beyond discharge from the intensive care unit. Because the mortality benefit was evident only on this subgroup analysis, further studies are required to validate the results.

Clinical guide:

Despite mechanical ventilation — the primary treatment used in ARDS to improve arterial oxygenation — a significant number of people remain hypoxaemic. [43] Prone position ventilation may help in 60–70% of people. [38] Because not everyone will respond, a brief test of the prone position is recommended to assess responsiveness. The review recommended that an increase in PaO_2 within the first 60 minutes after prone positioning predicts continued improvement for several hours. The optimal duration of this treatment, and the repeat benefit of successive trials, are not currently known.

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