May 2017 Phoenix Pulmonary/Critical Care Journal Club

The Berlin definition of ARDS is: bilateral radiographic opacities (not effusion, atelectasis or nodules) of <1 week duration, not fully explained by cardiac failure or fluid overload, associated with PaO_2/FiO_2 <300 (1). This definition is highly inclusive. A recent international epidemiologic study showed that ARDS accounts for 10% of ICU admissions and about a quarter of patients requiring mechanical ventilation. ARDS is often undiagnosed and undertreated (2). Survival is associated with PaO_2/FiO_2 ratio and is 45% in patients with P/F <100 (1,2).

Banner Health is embarking on a quality improvement effort focused on management of patients with ARDS and the aim of our journal club was to develop an evidence-based clinical practice for ARDS. We reviewed what we considered the ten most influential articles regarding ARDS published since 2000. We did not include interventions for which no benefit in important *clinical* outcomes has been demonstrated (for instance, the choice of one ventilator mode over another, or adjunctive therapies such as inhaled nitric oxide or corticosteroids for ARDS).

Each of the articles was critically appraised. In each case we considered whether a recommendation for clinical practice could be made based on three criteria: the strength of evidence, the magnitude of clinical benefit and the risk/cost associated with the intervention. Also, we suggested a process variable related to each recommendation that could be electronically tracked to follow the effect of any subsequent associated quality improvement efforts. Clinical decision support system (CDSS) logic can potentially be programmed to track each recommendation process measure and alert clinicians if recommendations are being overridden. The strength of recommendation can be used to support future decisions regarding how CDSS logic might be operationalized, i.e., weak recommendations should not be the basis of interruptive computerized decision support.

Recommendations for patients with ARDS:

1) Tidal volume should be 6mL/kg predicted body weight (PBW) and plateau pressure <30cmH_2O. Tidal volumes in the range of 4-8mL/kg PBW are allowable if necessary depending on the clinical situation as long as plateau pressure < 30 cmH_2O is maintained. Tidal volumes should not exceed 8mL/kg PBW.
Strength of evidence: multicenter RCT (3)
Clinical benefit: Survival, NNT= 11
Risk/cost: low – no increase in the number of days requiring sedation or neuromuscular blockade, but could theoretically lead to higher sedation doses in some patients. Permissive hypercapnia may necessitate bicarbonate infusion in some patients.
Strongly Recommended.
Measures: Percentage of mechanically-ventilated patients with TV >8mL/kg PBW, Percentage of patients with P_{plat} >30cmH_2O.

2) PEEP should be equal to or exceed "Low PEEP" settings as defined by ARDSnet consensus.

Strength of evidence: no evidence that one PEEP setting is better than another (4), but the concept of optimized PEEP is supported by sound physiological rationale.
Clinical benefit: unclear.
Risk/cost: low – no increased risk of barotrauma with higher PEEP levels.
Recommended.
Measure: *deferred to driving pressure recommendation below*.

3) Conservative fluid balance should be maintained once shock resuscitation is achieved.
Strength of evidence: single-center RCT (5).
Clinical benefit: Increase ventilator-free days by 2.5 days, increase ICU-free days by 2.2 days
Risk/cost: No increase in the incidence or prevalence of shock; no increase in need for renal replacement therapy.
Recommended.
Measure: Percentage of patients with >100mL/kg cumulative positive fluid balance not receiving intravenous vasopressors.

4) Adjunctive therapies (neuromuscular blockade, proning, ECMO center triage) should be considered early in the course of patients with moderate-severe ARDS with PaO_2/FiO_2 ratio < 150.
Strength of evidence: single-center RCTs.
Clinical benefit: neuromuscular blockade: survival NNT=11 (6); proning: survival, NNT=6 (7); ECMO triage: survival without disability NNT=6 (8).
Risk/cost: neuromuscular blockage – low, no increase in critical care weakness; proning – intermediate, requires experienced nursing team, some risk of displacing catheters; ECMO triage: high – many potential complications, high cost.
Comment: Patients with moderate to severe ARDS have 40-45% mortality, but further research is needed to reach consensus on best therapeutic approach.
Recommended.
Measure: Percentage of patients with PaO_2/FiO_2 ratio < 150 evaluated for adjunctive therapies by telemedicine ICU team.

5) Driving pressure should be monitored.
Strength of evidence: retrospective non-interventional meta-analysis (9).
Clinical benefit: survival.
Risk/cost: unknown, but likely low and similar to those of low-tidal volume ventilation.
Comment: Strong observational evidence shows that driving pressure, (not tidal volume, plateau pressure or PEEP) is the major determinant of treatment-related mortality in ARDS. Driving pressure could reasonably be used by an individual physician to optimize PEEP, but interventional studies are needed before that recommendation can be made.
Weakly Recommended.
Measure: % of patients with driving pressure > 22cmH_2O (one standard deviation above mean).

Recommendation for mechanically-ventilated patients without ARDS.
6) *Tidal volume should be 6mL/kg predicted body weight (PBW) and plateau pressure <30cmH_2O*.
Strength of evidence: meta-analysis (10).
Clinical benefit: survival NNT=23.
Risk/cost: low.
Comment: Prospective RCT needed. We cannot currently reliably differentiate ARDS from non-ARDS patients through the EMR using CDSS logic.
Weakly Recommended.
Measure: Percentage of mechanically-ventilated patients with TV >8mL/kg PBW, Percentage of patients with P_{plat} >30cmH_2O.

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