LIBERATION FROM MECHANICAL VENTILATION: A LOOK AT THE NEW AARC CLINICAL PRACTICE GUIDELINE

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OBJECTIVES

- EXAMINE PREVIOUS GUIDELINES/PRACTICES
- REVIEW CURRENT EVIDENCE
- DISCUSS THE UPDATED RECOMMENDATIONS

The goals of mechanical ventilation include optimizing oxygenation and ventilation, reducing the work of breathing, and allowing patient stabilization while diagnostic and therapeutic plans are implemented with the ultimate goal of weaning the patient from the ventilator.

Eur Respir J 2007; 29: 1033–1056
DOI: 10.1183/09031936.00010206

TASK FORCE

Weaning from mechanical ventilation

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Statement of the Sixth International Consensus Conference on Intensive Care Medicine

Organised jointly by the European Respiratory Society (ERS), the American Thoracic Society (ATS), the European Society of Intensive Care Medicine (ESICM), the Society of Critical Care Medicine (SCCM) and the Société de Réanimation de Langue Française (SRLF), and approved by the ERS Executive Committee, February 2007

ABSTRACT: Weaning covers the entire process of liberating the patient from mechanical support and from the endotracheal tube. Many controversial questions remain concerning the best methods for conducting this process. An International Consensus Conference was held in April 2005 to provide recommendations regarding the management of this process. An 11-member international jury answered five pre-defined questions. 1) What is known about the epidemiology of weaning problems? 2) What is the pathophysiology of weaning failure? 3) What is the usual process of initial weaning from the ventilator? 4) Is there a role for different ventilator modes in more difficult weaning? 5) How should patients with prolonged weaning failure be managed?

The main recommendations were as follows. 1) Patients should be categorised into three groups based on the difficulty and duration of the weaning process. 2) Weaning should be considered as early as possible. 3) A spontaneous breathing trial is the major diagnostic test to determine whether patients can be successfully extubated. 4) The initial trial should last 30 min and consist of either T-tube breathing or low levels of pressure support. 5) Pressure support or assist–control ventilation modes should be favoured in patients failing an initial trial/trials. 6) Noninvasive ventilation techniques should be considered in selected patients to shorten the duration of intubation but should not be routinely used as a tool for extubation failure.

HIGHLIGHTS Q. 1 WHAT IS KNOWN ABOUT THE EPIDEMIOLOGY OF WEANING PROBLEMS

- IT IS IMPORTANT TO RECOGNIZE THAT DELAY IN REACHING STAGE 2, THE SUSPICION THAT WEANING MAY BE POSSIBLE, AND BEGINNING STAGE 3, ASSESSING READINESS TO WEAN, IS A COMMON CAUSE OF DELAYED WEANING.
- THERE IS MUCH EVIDENCE THAT WEANING TENDS TO BE DELAYED, EXPOSING THE PATIENT TO UNNECESSARY DISCOMFORT AND INCREASED RISK OF COMPLICATIONS, AND INCREASING THE COST OF CARE. TIME SPENT IN THE WEANING PROCESS REPRESENTS 40–50% OF THE TOTAL DURATION OF MECHANICAL VENTILATION [4–7]. ESTEBAN ET AL.
- THE INCIDENCE OF UNPLANNED EXTUBATION RANGES 0.3-16% [11] IN MOST CASES (83%) THE UNPLANNED EXTUBATION IS INITIATED BY THE PATIENT, WHILE 17% ARE ACCIDENTAL [11] ALMOST HALF THE PATIENTS WITH SELF EXTUBATION DURING THE WEANING PERIOD DO NOT REQUIRE REINTUBATION [12] SUGGESTING THAT MANY PATIENTS ARE MAINTAINED ON MECHANICAL VENTILATION LONGER THAN NECESSARY

TABLE 2 Incidence of weaning success and failure

First author [Ref.]	Yr	Subjects	Failed initial SBT	Passed Initial SBT	Re-intubated	Total failed weaning	Successful weaning
FARIAS [24]	2001	257	56 (22)	201	28 (14)	84 (32.7)	173
ESTEBAN [22]	1999	526	73 (14)	453	61 (13)	134 (25.5)	392
VALLVERDU [17]	1998	217	69 (32)	148	23 (16)	92 (42.4)	125
ESTEBAN [25]	1997	484	87 (18)	397	74 (19)	161 (33.3)	323
ESTEBAN [16]	1995	546	130 (24)	416	58 (14)	188 (34.4)	358
BROCHARD [18]	1994	456	109 (24)	347	8 (3)	117 (25.6)	339
Total		2486	524/2486 (21%)	1962/2486 (79%)	252/1962 (13%)	776 (31.2%)	1710/2486 (68.8%)

Data are presented as n or n (%), unless otherwise stated. SBT: spontaneous breathing trial

AARC 2024 CLINICAL PRACTICE GUIDELINE

AARC Clinical Practice Guideline: Spontaneous Breathing Trials for Liberation From Adult Mechanical Ventilation

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- RESPIRATORY CARE PAPER IN PRESS. PUBLISHED ON MARCH 5, 2024 AS DOI: 10.4187/RESPCARE.11735

WHY NEW GUIDELINES/RECOMMENDATIONS?

- PREVIOUS GUIDELINES PUBLISHED IN 2001 CONTAIN SOME RECOMMENDATIONS THAT COULD BE CONSIDERED QUESTIONABLE TODAY- (THIS TABLE IN INCLUDED IN THE CURRENT CPG)
- WEANING/DISCONTINUATION PROTOCOLS SHOULD BE DEVELOPED FOR NON-PHYSICIAN HEALTHCARE PROFESSIONALS SHOULD BE DEVELOPED AS WELL AS OPTIMIZATION OF SEDATION SHOULD BE DEVELOPED AND IMPLEMENTED
- ANESTHESIA/SEDATION STRATEGIES AND VENT MANAGEMENT AIMED AT EARLY EXTUBATION IN POSTSURGICAL PATIENTS
- WEANING STRATEGIES IN THE PROLONGED MECHANICALLY VENTILATED PATIENT SHOULD BE SLOW PACED AND SHOULD INCLUDE GRADUALLY LENGTHENING SELF-BREATHING TRIALS

Table 1. American College of Chest Physicians-Society of Critical Care Medicine-American Association for Respiratory Care 2001 Ventilator Weaning/Discontinuation Guidelines

1. In patients requiring mechanical ventilation for > 24 h, a search for all causes that may be contributing to ventilator dependence should be undertaken. Reversing all possible ventilatory and non-ventilatory issues should be an integral part of the ventilator discontinuation process.
2. Patients receiving mechanical ventilation for respiratory failure should undergo a formal assessment of discontinuation potential if the following criteria are satisfied: evidence for some reversal of the underlying cause for respiratory failure, adequate oxygenation and pH, hemodynamic stability, and capability to initiate an inspiratory effort.
3. Formal discontinuation assessments for patients receiving mechanical ventilation for respiratory failure should be done during spontaneous breathing rather than while the patient is still receiving substantial ventilatory support.
4. Removal of the artificial airway from a patient who has successfully been discontinued from ventilatory support should be based upon assessments of airway patency and the ability of the patient to protect the airway.
5. Patients receiving mechanical ventilation for respiratory failure who fail an SBT should have the cause for the failed SBT determined. Once reversible causes for failure are corrected, subsequent SBTs should be performed every 24 h.
6. Patients receiving mechanical ventilation for respiratory failure who fail an SBT should receive a stable, non-fatiguing, comfortable form of ventilatory support.
7. Anesthesia/sedation strategies and ventilator management aimed at early extubation should be used in postsurgical patients.
8. Weaning/discontinuation protocols designed for non-physician health care professionals should be developed and implemented by ICUs. Protocols aimed at optimizing sedation should also be developed and implemented.
9. Tracheostomy should be considered after an initial period of stabilization on the ventilator when it becomes apparent that the patient will require prolonged ventilator assistance.
10. Unless there is evidence for clearly irreversible disease (eg, high spinal cord injury, advanced amyotrophic lateral sclerosis), a patient requiring prolonged mechanical ventilatory support for respiratory failure should not be considered permanently ventilator-dependent until 3 months of weaning attempts have failed.
11. When medically stable for transfer, patients who have failed ventilator discontinuation attempts in the ICU should be transferred to those facilities that have demonstrated success and safety in accomplishing ventilator discontinuation.
12. Weaning strategy in the prolonged mechanically ventilated patient should be slow paced and should include gradually lengthening self-breathing trials.

From Reference 7.
SBT = spontaneous breathing trial

AMERICAN COLLEGE OF CHEST PHYSICIANS/AMERICAN THORACIC SOCIETY 2017 GUIDELINES FOR LIBERATION FROM MECHANICAL VENTILATION

Table 2. American College of Chest Physicians/American Thoracic Society 2017 Guidelines for Liberation From Mechanical Ventilation

1. For acutely hospitalized patients ventilated > 24 h, the initial SBT should be conducted with inspiratory pressure augmentation (5–8 cm H_2O) rather than without (T-piece or CPAP).
2. For acutely hospitalized patients ventilated for > 24 h, use protocols attempting to minimize sedation.
3. For patients at high risk for extubation failure who have been receiving mechanical ventilation for > 24 h, and who have passed an SBT, extubate to preventive NIV.
4. For acutely hospitalized patients who have been mechanically ventilated for > 24 h, use protocolized rehabilitation directed toward early mobilization.
5. Manage acutely hospitalized patients who have been mechanically ventilated for > 24 h with a ventilator liberation protocol.
6. Perform a cuff leak test in mechanically ventilated adults who meet extubation criteria and are deemed at high risk for postextubation stridor.
7. For adults who have failed a cuff leak test but are otherwise ready for extubation, administer systemic steroids at least 4 h before extubation; a repeated cuff leak test is not required.

From Reference 10.
SBT = spontaneous breathing trial
NIV = noninvasive ventilation

DECISION TO UPDATE AND DEVELOPMENT OF PICO QUESTIONS

- "DESPITE PRIOR PUBLICATIONS OF CLINICAL PRACTICE GUIDELINES RELATED TO VENTILATOR LIBERATIONS, SOME QUESTIONS REMAIN UNANSWERED. MANY OF THESE QUESTIONS RELATE TO THE DETAILS OF BEDSIDE IMPLEMENTATION."
- PICO FOR BEDSIDE RT'S.
- P (PARTICIPANT, PROBLEM OR POPULATION
- I (INTERVENTION)
- C (CONTROL OR COMPARATOR)
- O (OUTCOME)

AARC CPG: SPONTANEOUS BREATHING TRAILS FOR LIBERATION FROM ADULT MECHANICAL VENTILATION 2024 – PICO QUESTIONS

1. IN ADULT MECHANICALLY VENTILATED PATIENTS, DOES INCLUDING A RAPID SHALLOW BREATHING INDEX PREDICT THE SUCCESSFUL COMPLETION OF AN SBT?
2. IN ADULT MECHANICALLY VENTILATED PATIENTS RECEIVING AN SBT, DOES PSV INCREASE LIBERATION AND EXTUBATION SUCCESS?
3. IN ADULT MECHANICALLY VENTILATED PATIENTS RECEIVING AN SBT, DOES THE TIME OF DAY OR NIGHT FOR THE SBT AFFECT SUCCESSFUL LIBERATION?
4. IN ADULT MECHANICALLY VENTILATED PATIENTS RECEIVING AN SBT, DOES AN INCREASE IN THE FI02 DURING THE SBT INCREASE SUCCESSFUL LIBERATION?

IN ADULT MECHANICALLY VENTILATED PATIENTS, DOES INCLUDING A RAPID SHALLOW BREATHING INDEX PREDICT THE SUCCESSFUL COMPLETION OF AN SBT?
(PICO 1)

- BACKGROUND – 1991 YANG AND TOBIN INTRODUCED THE RSBI (RATIO OF FREQUENCY TO TIDAL VOLUME) THEY REPORTED THAT RSBI WITH A CUT OFF OF <105 MORE ACCURATELY PREDICTED LIBERATION SUCCESS THAN OTHER MEASURES.
- MEADE ET AL IDENTIFIED 65 STUDIES WHICH POOLED LIKELIHOOD RATIOS WHICH PREDICTED LOWER PROBABILITY OF SUCCESSFUL EXTUBATION WHEN F >38 AND THE RSBI WAS >100.
- SUBSEQUENTLY RSBI GAINED FAVOR
- HOWEVER AN INTERNATIONAL SURVEY OF CRITICAL CARE PHYSICIANS IN 2018 REPORTED THAT 51% DID NOT USE THE RSBI

HIGHLIGHTS FROM SUMMARY OF THE EVIDENCE (PICO 1)

- A 2022 SYSTEMATIC REVIEW AND META-ANALYSIS EVALUATED THE USEFULNESS OF RBSI FOR PREDICTING SUCCESSFUL EXTUBATION.
- ALL POOLED SUBJECTS DEMONSTRATED SIGNIFICANT HETEROGENEITY (48 STUDIES, 10,946 SUBJECTS)
- AFTER REVIEW AN RSBI <105 HAS MODERATE SENSITIVITY (0.83 95% CI 0.78-0.87) MODERATE CERTAINLY AND POOR SPECIFICITY FOR PREDICTING EXTUBATION SUCCESS. (FALSE POSITIVES AND FALSE NEGATIVES)
- A SUBGROUP ANALYSES EVALUATED MEASUREMENT TECHNIQUE (T-PIECE, CPAP, PSV: NO SIGNIFICANT EFFECTS) AND AND TIMING OF RSBI MEASUREMENT RELATIVE TO TIME OF SBT (NO DIFFERENCES WERE FOUND)
- AUTHORS CONCLUSION – AS A STAND-ALONE TEST, THE RSBI HAS MODERATE SISITIVITY AND POOR SPECIFICITY FOR PREDICTING EXTUBATION SUCCESS

RECOMMENDATION – FUTURE RESEARCH OPPORTUNITIES

- RECOMMENDATION. WE SUGGEST THAT AN RSBI IS NOT NEEDED TO DETERMINE READINESS FOR SBT (CONDITIONAL; MODERATE CERTAINTY)
- FUTURE STUDIES SHOULD FOCUS ON THE POTENTIAL BENEFIT OF RSBI IN FOCUSED SUBJECT POPULATIONS SUCH AS SUBJECTS WITH INTERMEDIATE PRETEST PROBABILITY AS SUGGESTED I THE STUDY BY TRIVEDI ET AL.
- THERE IS ALSO INTEREST I THE POTENTIAL FOR NONIVASIVE IMAGING TECHNIQUES SUCH AS DIAPHRAGMATIC ULTRASOUND AND EIT AS PREDICTORS OF VENTILATION LIBERATION. THE BENEFIT OF EITHER ALONE OR IN COMBINATION WITH AN RSBI, IS YET TO BE DETERMINED.

IN ADULTS MECHANICALLY VENTILATED PATIENTS RECEIVING AN SBT, DOES PSV INCREASE LIBERATION AND EXTUBATION SUCCESS? (PICO 2)

- BACKGROUND – IN 1997, ESTEBAN ET AL CONDUCTED AN RCT COMPARING SBT'S CONDUCTED WITH T-PIECE VS SBT'S WITH 7CMH20 PSV.
- T-PIECE FAILURE RATE WAS SIGNIFICANTLY HIGHER THEN PSV.
- HOWEVER, THE PERCENTAGE OF SUBJECTS WHO REMAINED EXTUBATED AFTER 48 HOURS WAS NOT DIFFERENCT BETWEEN THE TWO GROUPS
- ALTHOUGH THE AUTHORS CONCLUDED THAT SBT WITH EITHER PSV OR T-PIECE ARE SUITABLE, THIS STUDY LED TO WIDESPERAD ACCEPTANCE OF LOW-LEVEL PSV DURING SBT'S.
- BURNS ET AL FOUND THAT INITIAL SBT'S MOST OFTEN USED PSV WITH PEEP OR T-PIECE AND LESS FREQUENTLY CPAP OR PSV WITHOUT PEEP. SBT'S WITH PSV/PEEP WERE COMMONLY USED IN NORTH AMERICAN WHEREAS T-PIECE WAS COMMONLY USED IN EUROPE. ** THE PREVIOUSLY PUBLISHED ACCP/ATS CPG MADE A CONDITIONAL (WEAK)RECOMMENDATION FOR USE OF PSV FOR THE INITIAL SBT.

HIGHLIGHTS FROM SUMMARY OF THE EVIDENCE (PICO 2)

- EVIDENCE TO THIS PICO CONSISTS OF 5 SYSTEMATIC REVIEWS AND 4 RCT'S.
- SUBIRA ET AL RANDOMINZED 2 HOUR T-PIECE SBT, OR 30 MIN SBT WITH 8CMH20 PSV. SUCCESSFUL EXTUBATION OCCURRED IN 473 SUBJECTS IN PSV GROUP AND 428 SUBJECTS IN T-PIECE GROUP
- COMPLICATING THE INTERPRETATION IS THE DIFFERNCE IN DURAITON OF THE TRIALS- THUS UNCLEAR WHETHER THE IMPROVED OUTCOMES WERE ATTRIBUTABLE TO MODE (PSV VS T-PIECE) DURATION (30 VS 120 MINS) OR BOTH.
- ANOTHER STUDY (THILLE ET AL) LOOKED TO DETERMINE IF PSV WITH ZEEP OR T-PIECE RESULTED IN SHORTER TIME TO EXTUBATION – AUTHORS CONCLUDED THAT DID NOT RESULT IN SIGNIFICANTLY MORE VENTILATOR FREE DAYS AT DAY 28 (PSV VS T-PIECE)
- ALSO INCLUDED WAS TRACHEOSTOMY WITH UNASSISTED BREATHING COMPARED TO WEANING WITH GRAUDUAL REDUCTION IN PSV RESULTED IN SHORTER LIBERATION TIME

RECOMMENDATION – FUTURE RESEARCH OPPORTUNITIES

- RECOMMENDATION. WE SUGGEST THAT SBT'S CAN BE CONDUCATED WITH OUR WITHOUT LOW-LEVEL PSV (≤8CMH20). (CONITIONAL RECOMMENDATION, MODERATE CERTAINTY)
- THERE MIGHT BE POPULATIONS FOR WHOM ONE OR THE OTHER APPROACH IS BETTER. IN PATIENTS WITH CARDIAC FAILURE, THERE IS POTENTIAL FOR ACTURE CARDIOGENIC PULMONARY EDEMA WHEN PP IS REMOVED. IN PATIENTS WITH COPD AND AUTO-PEEP, THE REMOVAL OF PP MIGHT RESULT IN INCREASED EFFORT TO BREATH. FOR PATIENTS WITHOUT PSV MIGHT RESULT IN EXCESSIVE INSPIRATORY MUSCLE LOAD. WHETHER THESE SUBGROUPS OF PATIENTS MIGHT BENEFIT FROM PSV SBT IS WORTHY OF STUDY.

IN ADULT MECHANICALLY VENTILATED PATIENTS RECEIVING AN SBT, DOES THE TIME OF DAY OR NIGHT FOR THE SBT AFFECT SUCCESSFUL LIBERATION? (PICO 3)

- BACKGROUND – IN 1996 ELY ET ALL PUBLISHED A RCT THAT BECAME A PRIMER FOR EVALUATIING PATIENTS FOR LIBERATION FROM MV.
- RT'S CONDUCTED SCREENING FOR SBT'S BETWEEN 6:30-7:00AM – THEY PROCEEDED WITH SBT IF THEY SUCCESSFULLY PASSED 5 SCREENING CRITERIA
- COMPARED WITH PHYSICIAN DIRECTED LIBERATION THE RT PROTOCOL RESULTED IN SIGNIFICANLY FEWER NUMBER OF DAYS OF MV. RESULTING IN WIDESPREAD UPTAKE TO THIS PRACTICE. THERE IS LESS IMPETUS FOR TEAMS TO ALTER OR EXPAND THE PROCESS-
- HOWEVER- THERE IS MUCH VARIATION IN THE IMPLEMENATION OF THE LIBERATION PROCESS AMONG CRITICAL CARE AREAS

HIGHLIGHTS OF THE SUMMARY OF EVIDENCE (PICO 3)

- A PAUCITY OF STUDIES TO FURTHER UNDERSTANDING OF THE QUESTION
- FEW ARTICLES MENTIONED TIME OF DAY AND NO RCT'S THAT DIRECTLY ASSESSED IMPACT OF TIME OF DAY.
- STUDIES BY ELY ET AL AND TANIOS ET ALL REFERRED TO AM ASSESSMENTS
- ESTEBAN ET AL REPORTED THAT ONCE DAILY SBT'S LED TO EARLIER LIBERTATION THAN SIMV OR PSV WEANING BUT NO DIFFERENCE IN SPEED OF LIBERATION BETWEEN ONCE DAILY OR MULTIPLE SBT'S PER DAY
- PATEL ET AL COMPARED RSBI MEASUREMENTS IN MORNING VS EVENING. THE PRECISE TIME IN THE PROTOCOL WAS NOT SPECIFIED OTHER THAN TO SAY THEY SHOULD BE > 4 HOURS APART, AND THAT THERE WAS NO SIGNIFICANT DIFFERENCES IN RSBI MEASURED IN THE MORNING VS THE EVENING

RECOMMENDATION – FUTURE RESEARCH OPPORTUNITIES

- RECOMMENDATIONS. WE SUGGEST A STANDAERDIZED APPROACH TO ASSESMMENT AND, IF APPROPRIATE, COMPLETION OF AN SBT BEFORE NOON EACH DAY (CONDITIONAL RECOMMENDATION, VERY LOW CERTAINTY)
- COMMON PRACTICE SEEMS TO BE THAT SBT'S ARE PERFROMED IN THE MORNING – BASED ON A VERY LOW LEVEL OF CERTAINTY. THIS ADDITONAL STUDIES ARE NEEDED TO DETERMINE WHETHER SBT'S CAN BE SUCCESSFUL WHEN PERFORMED AT OTHER TIMES OF THE DAY.
- ANDERSON ET AL IMPLEMENTED AN AUTOMATED REAL-TIME DASHBORAD THAT TRANSFERRED PATIENTS READINESS FOR LIBERATION AND ALERTED CLINICIANS WHEN ACCEPTABLE PARMAMETERS WERE ESTABLISHED. THIS PROOF OF CONCEPT STUDY DEMONSTRATED A FSTER TIME TO EXTUBATION AND DECREASE IN ICU LOS
- ADDITIONAL STUDY IS NEEDED TO DETERMINE WHETHER REAL TIME UPDATES RESULT IN MORE RAPID LIBERATION RATHER THAN PROTOCOLS TAILORED TO CLINICIAN CONVENIENCE

IN ADULT MECHANICALLY VENTILATED PATIENTS RECEIVING AN SBT DOES AN INCREASE IN FI02 DURING THE SBT INCREASE SUCCESSFUL LIBERATION?
(PICO 4)

- BACKGROUND – ACCEPTABLE OXYGENATION IS A USUAL CRITERION ASSESSED BEFORE INITATING AN SBT.
- COMMON CRITERIA TO DESCRIBE ADEQUATE OXYGENATION PRIOR TO SBT ARE SP02 >90% WITH FI02 $\leq$.40, OR PF >200MMHG.
- ADEQUACY OF OXYGENATION IS ALSO EVALUATED TO DETERMINE TOLERANCE OF SBT, COMMONLY AN SBT IS TERMINATED IF SPO2 FALLS BELOW 90%
- THE PRACTICE IN SOME ICU'S IS TO INCREASE THE FI02 DURING AN SBT, PRESUMABLE TO MITIGATE THE POTENTIAL FOR HYPOXEMIA DURING THE PROCEDURE.
- HOWEVER, IT IS UNCLEAR WHETHER SUCH PRACTICE AFFECTS SUCCESSFUL DETERMINATION.

HIGHLIGHTS OF THE SUMMARY OF EVIDENCE (PICO 4)

- OUR SEARCH IDENTIFIED NO LITERATURE EVALUATING THE EFFECT OF FI02 INCREASE ON THE OUTCOME OF OF AN SBT. THUS, WE EVALUATED THE FI02 USED IN WHAT WE CONSIDER 10 SIMANL RCT'S. (SEE TABLE NEXT SLIDE)
- WE CONSIDERED THIS INDIRECT EVIDENCE, IN LIEU OF ANY RCT'S DIRECTLY ADDRESSING THE QUESTION, TO PROVIDE GUIDEANCE AND INFORM PRACTICE REGARDING THE STTING OF FI02 DURING AN SBT.

Table 5. Management of Oxygenation in Randomized Controlled Trials of Ventilator Liberation

Authors	Study Objective	Oxygenation Criteria for SBT Initiation	F_{IO_2} During SBT	Oxygenation Criteria for SBT Termination
Brochard et al[2]	Comparison of 3 methods of weaning	$S_{pO_2} > 90\%$ with an F_{IO_2} 0.40	F_{IO_2} was kept at level used during mechanical ventilation	$P_{aO_2} < 50$ mm Hg
Esteban et al[3]	Comparison of 4 methods of weaning	$P_{aO_2}/F_{IO_2} > 200$ mm Hg	F_{IO_2} at same level as used during mechanical ventilation	$S_{pO_2} < 90\%$
Ely et al[4]	RT protocol to notify physicians when patients successfully complete SBT	$P_{aO_2}/F_{IO_2} > 200$ mm Hg	No change made in F_{IO_2}	$S_{pO_2} < 90\%$
Esteban et al[23]	SBT with T-piece or pressure support	$P_{aO_2} > 60$ mm Hg with $F_{IO_2} \leq 0.40$	F_{IO_2} at the same level as used during mechanical ventilation	$S_{pO_2} < 90\%$
Esteban et al[5]	Evaluation of SBT duration	$P_{aO_2} > 60$ mm Hg with $F_{IO_2} \leq 0.40$	F_{IO_2} at the same level as used during mechanical ventilation	$S_{pO_2} < 90\%$
Tanios et al[17]	Evaluate effect of including rapid shallow breathing index in a weaning protocol	$P_{aO_2}/F_{IO_2} > 150$ mm Hg or $S_{pO_2} > 90\%$ at $F_{IO_2} \leq 0.40$	Changes of ventilator setting only allowed at the discretion of the managing physician	$P_{aO_2} < 60$ mm Hg or $S_{pO_2} < 90\%$ on $F_{IO_2} \geq 0.40$
Girard et al[5]	Efficacy and safety of a paired sedation and weaning protocol	$S_{pO_2} > 88\%$ on $F_{IO_2} \leq 0.50$	F_{IO_2} at the same level as used during mechanical ventilation	$S_{pO_2} < 88\%$ for ≥ 5 min
Fernandez et al[46]	1 h reconnection of mechanical ventilation after successful SBT	$S_{pO_2} > 90\%$ on $F_{IO_2} \leq 0.50$	No change made in F_{IO_2}	$S_{pO_2} < 90\%$
Subirà et al[30]	Compare 30 min of pressure-support ventilation to 2 h of T-piece	$S_{pO_2} > 90\%$ with $F_{IO_2} \leq 0.40$	No change made in F_{IO_2}	$S_{pO_2} < 90\%$ with $F_{IO_2} > 0.50$
Thille et al[31]	SBT with pressure-support ventilation or T-piece	$S_{pO_2} \geq 90\%$ with $F_{IO_2} \leq 0.40$	$F_{IO_2} \leq 0.40$	$S_{pO_2} < 90\%$ with $F_{IO_2} \geq 0.40$

SBT = spontaneous breathing trial
RT = respiratory therapist

RECOMMENATION AND FUTURE RESEARCH OPPORTUNITES (PICO 4)

- RECOMMENDATION – WE SUGGEST THAT FI02 SHOULD **NOT** BE INCREASED DURING AN SBT (CONDITIONAL RECOMMENDATION, VERY LOW CERTAINTY)
- TO THE BEST OF OUR KNOWLEDGE, THE EFFECT OF RAISING FI02 DURING AN SBT ON IMPORTANT PATIENT OUTCOMES HAS NOT BEEN STUDIED.
- IT APPEARS THAT RCT'S EVALUATING SBT'S ADOPTED OXYGENATION CRITERIA USED IN OLDER TRIALS DATING BACK TO THE 1990'S.
- THE COMMON PRACTICE OF REQUIRING AN SPO2 >90% WITH AN FI02 .40 PRIOR TO SBT INITIATION MAY BE TOO CONSERVATIVE. CONDUCTING STUDIES TO ESTABLISH AN APPROPRIATE LEVEL OR ARTERIAL OXYGENATION FOR THE INITIATION OF AN SBT IS IMPORTANT FOR FUTURE CONSIDERATION.
- STUDIES SHOULD ALSO EXPLORE WHETHER USING HIGHER FI02, ESPECIALLY WHEN EMPLOYING NIV OR HHFNC AFTER EXTUBATION LEADS TO EARLIER EXTUBATION.

IN CONCLUSION

- THE RECOMMENDATIONS SHOULD LEAD TO MORE RAPID IMPLEMENTATION OF SBT'S INCLUDING NO NEED FOR AN RBSI AS A SCREENING TOOL, PRESSURE SUPPORT OR NOT PER CLINICIAN/INSTITUTIONAL PREFERENCE, NO NEED TO ADJUST FI02, AND IMPLEMENTATION IN THE MORNING. EACH OF THESE CAN EASILY BE INCORPORATED INTO LOCAL PROTOCOLS.
- ALL RECOMMENDATIONS ARE CONDITIONAL (LACKING HIGH LEVEL OF EVIDENCE) THIS MEANS THAT DIFFERENT CHOICES ARE LIKELY TO BE APPROPRIATE FOR DIFFERENT PATIENTS AND THERAPY SHOULD BE TAILORED TO THE INDIVIDUAL PATIENT CIRCUMSTANCES.

QUESTIONS?