

Adaptive Support Ventilation (ASV)

This bibliography is a literature reference for users and represents selected relevant publications, without any claim to completeness.

Table of Contents

1	A randomized controlled trial comparing the ventilation duration between Adaptive Support Ventilation and Pressure Assist/Control Ventilation in medical patients in the ICU	4
2	Adaptive support ventilation for faster weaning in COPD: a randomised controlled trial	5
3	Adaptive support ventilation for fast tracheal extubation after cardiac surgery: a randomized controlled study	6
4	A randomized controlled trial of adaptive support ventilation mode to wean patients after fast-track cardiac valvular surgery	7
5	Adaptive Support Ventilation versus Synchronized Intermittent Mandatory Ventilation with Pressure Support in weaning patients after orthotopic liver transplantation	7
6	Randomized controlled trial comparing adaptive-support ventilation with pressure-regulated volume-controlled ventilation with automode in weaning patients after cardiac surgery	8
7	Automatic "respirator/weaning" with adaptive support ventilation: the effect on duration of endotracheal intubation and patient management	9
8	Adaptive support ventilation for complete ventilatory support in ARDS: a pilot randomized controlled trial	10
9	Human versus Computer Controlled Selection of Ventilator Settings: An Evaluation of Adaptive Support Ventilation and Mid-Frequency Ventilation	11
10	Effects of implementing adaptive support ventilation in a medical intensive care unit	12
11	Adaptive support ventilation versus conventional ventilation for total ventilatory support in acute respiratory failure	13
12	Automatic selection of breathing pattern using adaptive support ventilation	14
13	Correlation between transition percentage of minute volume (TMV%) and outcome of patients with acute respiratory failure	15
14	A randomized controlled trial of 2 protocols for weaning cardiac surgical patients receiving adaptive support ventilation	15
15	Comparing the effects of adaptive support ventilation and synchronized intermittent mandatory ventilation on intubation duration and hospital stay after coronary artery bypass graft surgery	16
16	Intelligent ventilation in the intensive care unit	17
17	Adaptive support and pressure support ventilation behavior in response to increased ventilatory demand	17
18	Determinants of tidal volumes with adaptive support ventilation: a multicentre observational study ...	18

19	Evaluation of adaptive support ventilation in paralysed patients and in lung model	18
20	Clinical experience with adaptive support ventilation for fast-track cardiac surgery	19
21	Patient-ventilator interactions during partial ventilatory support: a preliminary study comparing the effects of adaptive support ventilation with synchronized intermittent mandatory ventilation plus inspiratory pressure support	19
22	Automatic weaning from mechanical ventilation using an adaptive lung ventilation controller	20
23	Effects of adaptive support ventilation and synchronized intermittent mandatory ventilation on peripheral circulation and blood gas markers of COPD patients with respiratory failure	20
24	Comparison of 3 modes of automated weaning from mechanical ventilation: a bench study	21
25	Adaptive support ventilation prevents ventilator-induced diaphragmatic dysfunction in piglet: an in vivo and in vitro study	21
26	Correlation between the %MinVol setting and work of breathing during adaptive support ventilation in patients with respiratory failure	22
27	Adaptive support ventilation: an appropriate mechanical ventilation strategy for acute respiratory distress syndrome?	22
28	A comparison of adaptive Support Ventilation (ASV) and Conventional Volume-Controlled Ventilation on Respiratory Mechanics in Acute Lung Injury/ARDS	23
29	Adaptive support ventilation for gynaecological laparoscopic surgery in Trendelenburg position: bringing ICU modes of mechanical ventilation to the operating room	23
30	Adaptive Support Ventilation as the sole mode of ventilatory support in chronically ventilated patients	24
31	Adaptive lung ventilation (ALV) during anesthesia for pulmonary surgery: automatic response to transitions to and from one-lung ventilation	24
32	Continuous use of an adaptive lung ventilation controller in critically ill patients in a multi-disciplinary intensive care unit	25
33	Automatic selection of tidal volume, respiratory frequency and minute ventilation in intubated ICU patients as start up procedure for closed-loop controlled ventilation	25
	Additional files	26
34	Adaptive support ventilation	26
35	The work of breathing	26

36	Automated versus non-automated weaning for reducing the duration of mechanical ventilation for critically ill adults and children	27
37	Adaptive support ventilation: State of the art review	27
38	Closed loop mechanical ventilation	28

A randomized controlled trial comparing the ventilation duration between Adaptive Support Ventilation and Pressure Assist/Control Ventilation in medical patients in the ICU

Kirakli C, Naz I, Ediboglu O, Tatar D, Budak A, Tellioglu E

Chest. 2015 Mar 5. [Epub ahead of print]

PMID 25742308, <http://www.ncbi.nlm.nih.gov/pubmed/25742308>

Design	Randomized controlled trial ASV versus Pressure assist control ventilation
Patients	229 medical ICU patients from intubation to extubation
Objectives	Compare the MV duration, weaning duration, number of manual settings, and weaning success rates
Main Results	Total mechanical ventilation duration was significantly shorter in the ASV group, mean 5d [2-6 d] vs 4d [3-9] days). Mechanical ventilation duration until weaning and weaning duration were significantly shorter in the ASV group, mean (84 [43-94] hrs vs. 126 [61-165] hrs; 2 [2-2] hrs vs. 44 [2-80] hrs, respectively). ASV required fewer manual settings to reach the desired pH and PaCO ₂ . The number of patients successfully extubated on the first attempt was significantly higher in the ASV group. Weaning success and mortality at day 28 were comparable between the two groups.
Conclusion	ASV shortens total mechanical ventilation duration and the duration of weaning with fewer manual ventilator settings.

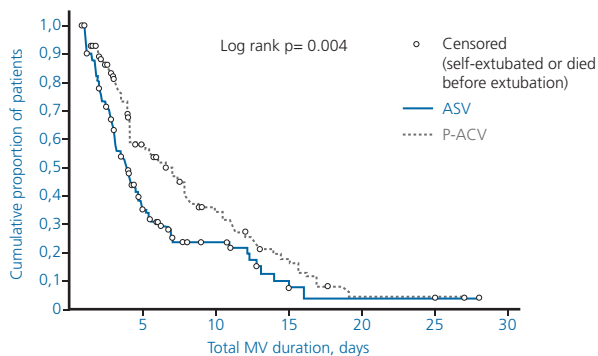


Figure 1: ASV shortens total mechanical ventilation duration compared with pressure assist/control ventilation

Adaptive support ventilation for faster weaning in COPD: a randomised controlled trial

Kirakli C, Ozdemir I, Ucar ZZ, Cimen P, Kepil S, Ozkan SA

Eur Respir J. 2011 Oct;38(4):774-80

PMID 21406514, <http://www.ncbi.nlm.nih.gov/pubmed/21406514>

Design	Randomized controlled trial ASV versus PS
Patients	97 COPD patients
Objectives	Compare weaning duration
Main Results	ASV shortened weaning times compared to PS (24 h vs 72 h, $p=0.041$) with similar success rate (35/49 for ASV and 33/48 for PS)
Conclusion	ASV was more efficient than PS in COPD patient's weaning.

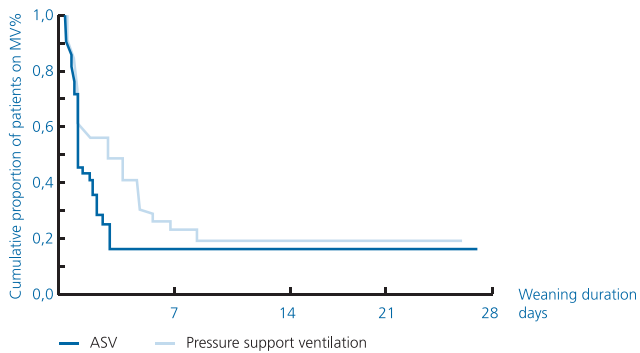


Figure 2: Patients were extubated earlier in ASV group.

Adaptive support ventilation for fast tracheal extubation after cardiac surgery: a randomized controlled study

Sulzer CF, Chioléro R, Chassot PG, Mueller XM, Revely JP

Anesthesiology. 2001 Dec;95(6):1339-45

PMID 11748389, <http://www.ncbi.nlm.nih.gov/pubmed/11748389>

Design	Randomized controlled trial ASV versus SIMV-PS with reduction of support in 3 phases
Patients	36 patients after coronary artery bypass for fast-track cardiac surgery
Objectives	Show that a protocol of weaning based on ASV could reduce the duration of intubation
Main Results	Duration of intubation was shorter in the ASV group (3.2 [2.5-4.6] vs. 4.1 [3.1-8.6] h; $p < 0.02$). Fewer arterial blood gases in ASV group. More fast-track succes in ASV group.
Conclusion	Weaning protocol based on ASV was feasible, accelerated tracheal extubation, and simplified ventilatory management in post-cardiac fast-track surgery.

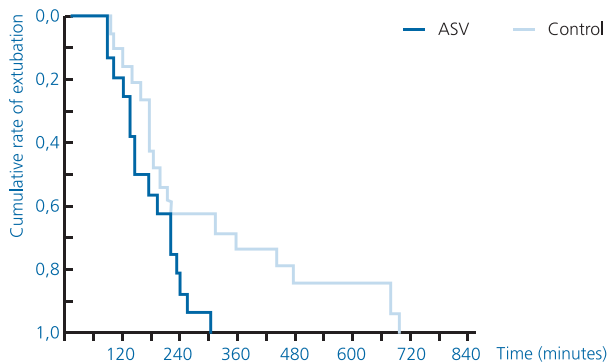


Figure 3: Patients were extubated earlier in ASV group than in control group.

A randomized controlled trial of adaptive support ventilation mode to wean patients after fast-track cardiac valvular surgery

Zhu F, Gomersall CD, Ng SK, Underwood MJ, Lee A

Anesthesiology. 2015 Apr;122(4):832-40

PMID 25569810, <http://www.ncbi.nlm.nih.gov/pubmed/25569810>

Design	Randomized controlled trial, ASV versus physician-directed weaning
Patients	68 patient after fast-track cardiac valvular surgery
Objectives	Compare the duration of mechanical ventilation
Main Results	Duration of ventilation was shorter in the ASV group 3.4 [2.3 to 4.9] hrs than in the control group 5.7 [3.6 to 8.2] hrs (P = 0.013). ASV was associated with fewer manual ventilator changes and alarms, and lower airway pressure.
Conclusion	ASV reduces duration of mechanical ventilation after fast-track cardiac valvular surgery and reduces the number of manual ventilator changes and alarms.

Adaptive Support Ventilation versus Synchronized Intermittent Mandatory Ventilation with Pressure Support in weaning patients after orthotopic liver transplantation

Celli P, Privato E, Ianni S, Babetto C, D'Arena C, Guglielmo N, Maldarelli F, Paglialunga G, Rossi M, Berloco PB, Ruberto F, Pugliese F

Transplant Proc. 2014 Aug 20 [Epub ahead of print]

PMID 25150607, <http://www.ncbi.nlm.nih.gov/pubmed/25150607>

Design	Randomized controlled trial, ASV versus SIMV with pressure support
Patients	20 patients after orthotopic liver transplantation fast-track surgery
Objectives	Compare the duration of intubation, the number of manual settings, high airway pressure (Paw) episodes, and blood gas analysis between the two modes
Main Results	The length of intubation was shorter in the ASV group than in the SIMV group (153 ±22 vs 90 ±13 minutes, p = 0.05). Settings modifications were more frequent in the SIMV group vs the ASV group (6 ±2 vs 1.5 ±1; p = .003). Peak pressure (P _{peak}) was higher in passive patients in the SIMV group. High Paw alarms were more frequent in the SIMV group in passive patients. The values of pH, PaCO ₂ , and e PaO ₂ did not differ significantly between the two groups.
Conclusion	ASV is superior in terms of weaning times, and it simplifies respiratory management

Randomized controlled trial comparing adaptive-support ventilation with pressure-regulated volume-controlled ventilation with automode in weaning patients after cardiac surgery

Gruber PC, Gomersall CD, Leung P, Joynt GM, Ng SK, Ho KM, Underwood MJ

Anesthesiology. 2008 Jul;109(1):81-7

PMID 18580176, <http://www.ncbi.nlm.nih.gov/pubmed/18580176>

Design	Randomized controlled trial ASV versus PRVC in 3 phases: controlled ventilation, assisted ventilation, T-piece trial
Patients	48 patients after coronary artery bypass, uncomplicated
Objectives	Evaluate the duration of intubation, duration of mechanical ventilation, number of arterial blood gases, and number of ventilator setting changes
Main Results	The duration of intubation and of mechanical ventilation was shorter in the ASV group than in the PRVC group (300 [205-365] vs. 540 [462-580] min; $p < 0.05$; 165 [120-195] vs. 480 [360-510] min; $p < 0.05$, respectively). There was no difference in the number of arterial blood gases and setting changes.
Conclusion	ASV allowed earlier extubation than PRVC in post-cardiac surgery without increasing the number of clinician interventions.

Automatic "respirator/weaning" with adaptive support ventilation: the effect on duration of endotracheal intubation and patient management

Petter AH, Chioléro RL, Cassina T, Chassot PG, Müller XM, Revely JP

Anesth Analg. 2003 Dec;97(6):1743-50

PMID 14633553, <http://www.ncbi.nlm.nih.gov/pubmed/14633553>

Design	Randomized controlled trial ASV versus SIMV-PS for post-cardiac fast-track surgery. 3 phases: controlled ventilation, supported ventilation, and SBT.
Patients	34 uncomplicated cardiac surgery patients
Objectives	Evaluate the effect of ASV on ventilator management and its ability to perform respiratory weaning
Main Results	ASV required fewer ventilator setting manipulations (2.4 ± 0.7 vs 4.0 ± 0.8 manipulations per patient; $p < 0.05$) and endured less high-inspiratory pressure alarms (0.7 ± 2.4 vs 2.9 ± 3.0 ; $p < 0.05$) than SIMV-PS. There was no difference in duration of mechanical ventilation and ICU stay.
Conclusion	ASV resulted in an outcome similar to the control group with less manipulation: it could simplify management of post-cardiac surgery patients.
Comment	Minute volume settings was left at 100% in the study. A further reduction may have transitioned patients to spontaneous breathing faster.

Adaptive support ventilation for complete ventilatory support in ARDS: a pilot randomized controlled trial

Agarwal R, Srinivasan A, Aggarwal AN, Gupta D

Respirology. 2013 Oct;18(7):1108-1

PMID 23711230, <http://www.ncbi.nlm.nih.gov/pubmed/23711230>

Design	Pilot randomized controlled trial ASV versus VC
Patients	48 ARDS patients
Objectives	Compare the outcomes
Main Results	Duration of mechanical ventilation (6 d for VC vs 5 d for ASV, $p=0.51$), ICU (9 d for VC vs 8 d for ASV, $p=0.9$), and hospital stay (11 d for VC vs 11 d for ASV, $p=0.97$), sedation doses, ease of use, and number of arterial blood gases were similar in the two groups. V_t was between 6 and 7 ml/kg during the first seven days.
Conclusion	ASV was usable in ARDS patients, providing the same outcomes as VC.
Comment	The sample size of this study could not show reduction of duration of mechanical ventilation (for comparison = 861 patients were necessary in ARDSnet trial) but there was a nonsignificant reduction of duration of mechanical ventilation and ICU stay in the ASV group.

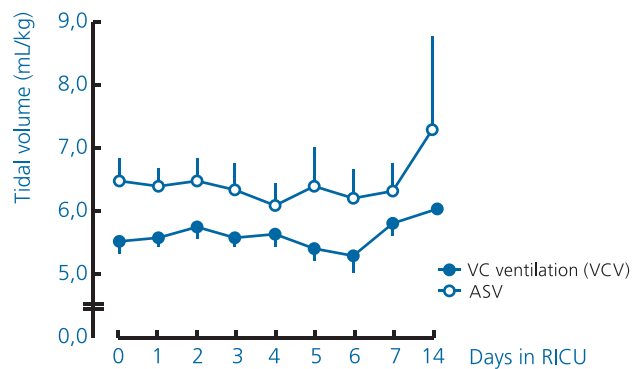


Figure 4: Tidal volume was between 6 and 7 mL/kg in ASV

Human versus Computer Controlled Selection of Ventilator Settings: An Evaluation of Adaptive Support Ventilation and Mid-Frequency Ventilation

Mireles-Cabodevila E, Diaz-Guzman E, Arroliga AC, Chatburn RL

Crit Care Res Pract. 2012 Sep;2012:204314

PMID 23119152, <http://www.ncbi.nlm.nih.gov/pubmed/23119152>

Design	Comparative simulation study
Patients	Lung simulator: normal lungs, ARDS, obesity, COPD, asthma
Objectives	Compare the automatic settings with survey-derived values
Main Results	Difference between Vt in ASV and clinician selected for normal lungs, ARDS, obesity, COPD were negligible (-0.9 ml to 0.7 ml). For asthma, Vt selected by ASV was greater than that selected by clinician by 3,9 mL.
Conclusion	Negligible differences occurred between ventilator settings selected by ASV and the clinician in different scenarios, except in asthma.

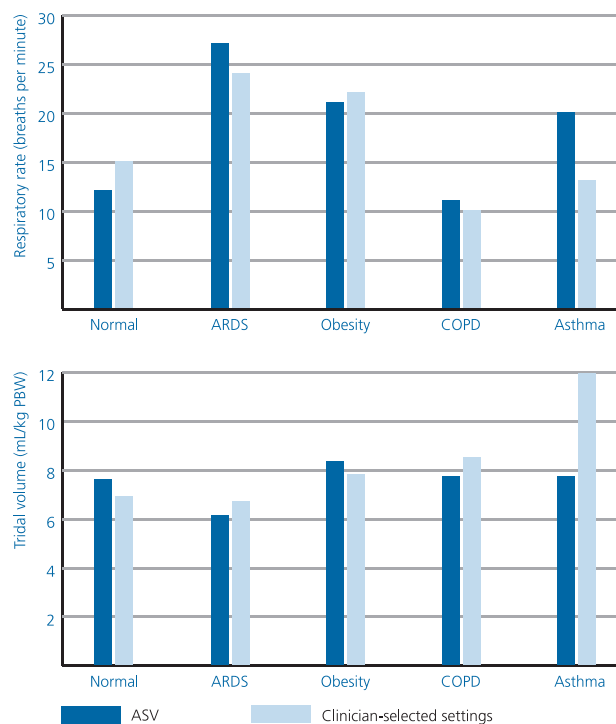


Figure 5: The only clinically relevant difference between the survey and the ASV settings was the higher Vt in status asthmaticus (but nonsignificant difference). Increasing Vt lead to decreased RR to avoid dynamic hyperinflation.

Effects of implementing adaptive support ventilation in a medical intensive care unit

Chen CW, Wu CP, Dai YL, Perng WC, Chian CF, Su WL, Huang YC

Respir Care. 2011 Jul;56(7):976-83

PMID 21352661, <http://www.ncbi.nlm.nih.gov/pubmed/21352661>

Design	Before/after study 6 months before ASV implementing
Patients	70 patients before (SIMV-PS) and 79 patients ventilated with ASV, in medical ICU
Objectives	Evaluate the effect of ASV in patients recovering from acute respiratory failure
Main Results	In the ASV group, 20% of the patients achieved extubation readiness within 1 day, compared to 4% in the non-ASV group. Patients in the ASV group were more likely to be free from mechanical ventilation at 3 weeks. Time-to-extubation readiness was 2 days shorter in the ASV group
Conclusion	ASV allowed early identification of extubation readiness and reduced weaning duration.

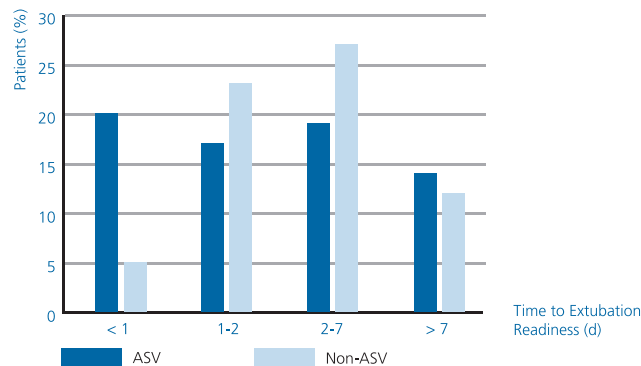


Figure 6: ASV reduced time to extubation readiness compared to conventional ventilation.

Adaptive support ventilation versus conventional ventilation for total ventilatory support in acute respiratory failure

Iotti GA, Polito A, Belliato M, Pasero D, Beduneau G, Wysocki M, Brunner JX, Braschi A, Brochard L, Mancebo J, Ranieri VM, Richard JC, Slutsky AS

Intensive Care Med. 2010 Aug;36(8):1371-9

PMID 20502870, <http://www.ncbi.nlm.nih.gov/pubmed/20502870>

Design	Prospective multicenter (6 european ICU) crossover study VC/PC switched for ASV with isoMV for 30 min, and 30 min more to achieve isoPaCO ₂ , if necessary
Patients	88 patients in 3 groups: 22 normal lung, 36 restrictive disease, 30 obstructive disease
Objectives	Compare the short-term effects of ASV with VC or PC in passive patient
Main Results	PaCO ₂ was lower with ASV than controlled ventilation for the same MV. For the same PaCO ₂ , ASV was associated with lower MV than controlled ventilation. Work of inspiration was lower during the ASV period. The combination V _t -RR varied with the group: lower V _t in patients with restrictive disease and prolonged T _{exp} in obstructive patients
Conclusion	ASV performed more effective ventilation than conventional modes

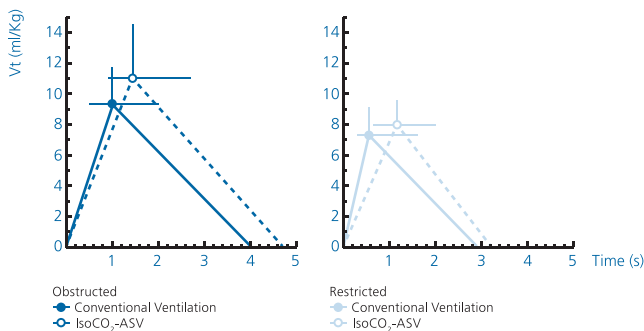


Figure 7: Ventilatory patterns were different between ASV and conventional ventilation. In obstructive patients, ASV provided more effective ventilation with higher V_t and lower RR than conventional ventilation. In restrictive patients, ASV decreased RR.

Automatic selection of breathing pattern using adaptive support ventilation

Arnal JM, Wysocki M, Nafati C, Donati S, Granier I, Corno G, Durand-Gasselín J

Intensive Care Med. 2008 Jan;34(1):75-81

PMID 17846747, <http://www.ncbi.nlm.nih.gov/pubmed/17846747>

Design	Prospective observational cohort study
Patients	243 ICU patients
Objectives	Compare settings automatically determined by ASV in 5 lung conditions: normal lungs, ARDS, COPD, chest wall stiffness, acute respiratory failure.
Main Results	On passive ventilation days, Vt-RR were different according to lung condition. On passive normal ventilation days, Vt was lower (8,3 ml/kgPBW) than in passive COPD days (9,3 ml/kg-PBW) and higher than in passive ALI/ARDS days (7,6ml/kgPBW, $p < 0,05$). On passive normal ventilation day, RR (14/min) was lower than in passive ALI/ARDS days (18/min).
Conclusion	On passive ventilation days, ASV selected different Vt-RR combinations based on respiratory mechanics

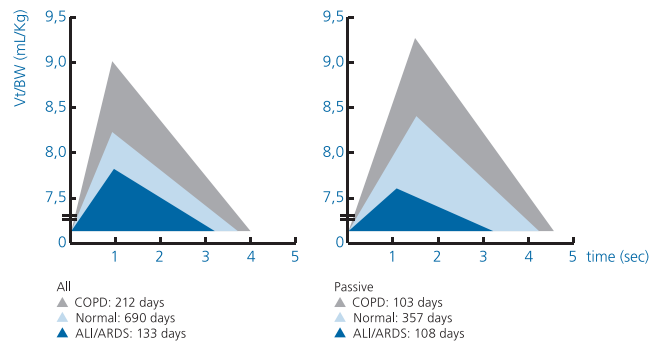


Figure 8: Vt and respiratory rate were different in all ventilation days and passive ventilation days according to lung condition.

Correlation between transition percentage of minute volume (TMV%) and outcome of patients with acute respiratory failure

Peng CK, Wu SF, Yang SH, Hsieh CF, Huang CC, Huang YT, Wu CP

J Crit Care. 2017 Jun;39:178-181

PMID 28278435, <http://www.ncbi.nlm.nih.gov/pubmed/28278435>

Design	Prospective observational study
Patients	336 ICU patients with acute respiratory failure
Objectives	Evaluate the association between patient outcomes and transition %MinVol (TMV%), namely the point where the patient's work of breathing begins to reduce that is determined by adjusting %MinVol until mandatory respiratory frequency is between 0 and 1 breaths/min
Main Results	In patients whose TMV% increased between day 1 and day 2, the adjusted odds ratio (aOR) for mortality was 7.0 (95%CI=2.7-18.3, p<0.001) compared to patients whose TMV% decreased. In patients whose TMV% was unchanged, the aOR for mortality was 3.91 (95%CI=1.80-8.22, p<0.01).
Conclusion	An increase or lack of a decrease in TMV% from day 1 to day 2 was associated with a higher risk of in-hospital death.

A randomized controlled trial of 2 protocols for weaning cardiac surgical patients receiving adaptive support ventilation

Tam MK, Wong WT, Gomersall CD, Tian Q, Ng SK, Leung CC, Underwood MJ

J Crit Care. 2016 Jun;33:163-8

PMID 27006266, <http://www.ncbi.nlm.nih.gov/pubmed/27006266>

Design	Randomized controlled trial: progressively reduced versus constant target minute ventilation
Patients	52 patients after elective coronary artery bypass surgery
Objectives	Compare the effectiveness of weaning using adaptive support ventilation (ASV) with a protocol incorporating a progressive reduction in target minute ventilation (decremental target minute ventilation (DTMV)) or a constant target minute ventilation
Main Results	Median duration of mechanical ventilation (145 versus 309 min; P = 0.001) and intubation (225 versus 423 min; P = 0.005) were significantly shorter in the DTMV group.
Conclusion	Use of a DTMV protocol for weaning after cardiac surgery shortens the duration of ventilation.

Comparing the effects of adaptive support ventilation and synchronized intermittent mandatory ventilation on intubation duration and hospital stay after coronary artery bypass graft surgery

Yazdannik A, Zarei H, Massoumi G

Iran J Nurs Midwifery Res. 2016 Mar-Apr;21(2):207-12

PMID 27095997, <http://www.ncbi.nlm.nih.gov/pubmed/27095997>

Design	Randomized controlled unblinded study
Patients	64 patients after coronary artery bypass surgery
Objectives	Compare the effects of ASV and SIMV on the mechanical ventilation duration and length of hospital stay
Main Results	Intubation duration was lower in the ASV group compared with the SIMV group (4.83 h vs 6.71 h, $p < 0.001$). The length of hospital stay was lower in the ASV group compared with the SIMV group (140.6 h vs 145.1 h, $p = 0.006$)
Conclusion	ASV reduced mechanical ventilation duration and length of hospital stay after cardiac surgery
Comment	Low impact factor journal

Intelligent ventilation in the intensive care unit

Sviri S, Bayya A, Levin P, Khalaila R, Stav I, Linton D
Sou Af J Crit Care. 2012 Aug;28(1): 6-12

Design	Retrospective study
Patients	1016 medical ICU patients
Objectives	Describe the clinical experience
Main Results	Duration of ventilation = 6 d. Weaning succes rate = 81%. 84% of patients ventilated with ASV mode. 96% able to wean solely using ASV mode. Less than 1% of all patient ventilated with ASV developed pneumothorax.
Conclusion	ASV was a safe and feasible mode of ventilation for complicated medical ICU patients.

Adaptive support and pressure support ventilation behavior in response to increased ventilatory demand

Jaber S, Sebbane M, Verzilli D, Matecki S, Wysocki M, Eledjam JJ, Brochard L
Anesthesiology. 2009 Mar;110(3):620-7
PMID 19225395, <http://www.ncbi.nlm.nih.gov/pubmed/19225395>

Design	Prospective randomized crossover study: ASV, APV, PS at baseline and with increase in dead space, in random order
Patients	14 ICU patients during assisted ventilation
Objectives	Compare ASV to APV and PS in respiratory demand increase
Main Results	Adding dead space increased MV, PaCO ₂ , work of breathing. ASV and PS ended with similar P _{insp} level (12 cmH ₂ O) while APV P _{insp} decreased (6 cmH ₂ O).
Conclusion	Following an increase in respiratory demand, ASV maintained the same level of pressure support; while adaptive pressure control modes such as APV, PRVC, and Autoflow, may reduce pressure support.

Determinants of tidal volumes with adaptive support ventilation: a multicentre observational study

Dongelmans DA, Veelo DP, Bindels A, Binnekade JM, Koppenol K, Koopmans M, Korevaar JC, Kuiper MA, Schultz MJ

Anesth Analg. 2008 Sep;107(3):932-7

PMID 18713908, <http://www.ncbi.nlm.nih.gov/pubmed/18713908>

Design	Prospective multicenter (3 Dutch ICU) observational comparative study in postcardiothoracic surgery
Patients	346 patients: 262 in ASV and 84 in PC-PS
Objectives	Determine Vt and factors that influence Vt
Main Results	In ASV, Vt was dependent on only two parameters: the RR and the correctness of set body weight
Conclusion	RR was automatically selected so the only clinically important factor was the correctness of set body weight.

Evaluation of adaptive support ventilation in paralysed patients and in lung model

Belliato M, Palo A, Pasero D, Iotti GA, Mojoli F, Braschi A

Int J Artif Organs. 2004 Aug;27(8):709-16

PMID 15478542, <http://www.ncbi.nlm.nih.gov/pubmed/15478542>

Design	Prospective observational and simulation study, 45 min in ASV during controlled ventilation, and simulation with the same parameters and increased by 30% of MV
Patients	21 post-operative patients
Objectives	Evaluate the respiratory pattern selected by ASV in 3 lung conditions: normal lungs, restrictive diseases, and obstructive diseases
Main Results	ASV selected higher Vt and lower RR in obstructive patients than in normal lung or restrictive patients. In simulation, patterns were the same. In the hyperventilation test, ASV chose a balanced increase in both Vt and RR.
Conclusion	ASV selected different parameters according to lung condition, and respiratory mechanics. In case of increase of target MV (hyperventilation), Vt and RR were increased.

Clinical experience with adaptive support ventilation for fast-track cardiac surgery

Cassina T, Chioléro R, Mauri R, Revelly JP

J Cardiothorac Vasc Anesth. 2003 Oct;17(5):571-5

PMID 14579209, <http://www.ncbi.nlm.nih.gov/pubmed/14579209>

Design	Prospective observational study ASV for post-cardiac fast-track surgery
Patients	155 uncomplicated cardiac surgery patients until recovery
Objectives	Evaluate ASV for ventilatory management during the post-operative period
Main Results	Tidal volume was 8.7 ± 1.4 ml/kgPBW, plateau pressure was 20.3 ± 3.9 cmH ₂ O, and arterial blood gas measurements were satisfactory. 86% were extubated within 6 h. No reintubation for respiratory failure. Considered easy to use by nurses and clinicians.
Conclusion	ASV was safe, feasible, and easy to apply, and allowed rapid extubation in post-cardiac surgery

Patient-ventilator interactions during partial ventilatory support: a preliminary study comparing the effects of adaptive support ventilation with synchronized intermittent mandatory ventilation plus inspiratory pressure support

Tassaou D, Dalmas E, Gratadour P, Jolliet P

Crit Care Med. 2002 Apr;30(4):801-7

PMID 11940749, <http://www.ncbi.nlm.nih.gov/pubmed/11940749>

Design	Prospective, crossover interventional study, 45 min in SIMV, then 45 min in ASV, then 45 min in SIMV
Patients	10 patients intubated for respiratory failure in the early weaning period
Objectives	Describe the effects of ASV and SIMV on patient-ventilator interactions
Main Results	MV was the same in the 3 phases but V _t increased and RR decreased in ASV period. During ASV, tidal volume increased (538 ± 91 vs. 671 ± 100 ml, $p < .05$) and total respiratory rate decreased (22 ± 7 vs. 17 ± 3 breaths/min, $p < .05$) vs. SIMV-PS. P 0.1 and sternocleidomastoid activity decreased in ASV period. Arterial blood gases and hemodynamic status remained stable.
Conclusion	ASV decreased inspiratory load and improved quality of patient-ventilator interaction.

Automatic weaning from mechanical ventilation using an adaptive lung ventilation controller

Linton DM, Potgieter PD, Davis S, Fourie AT, Brunner JX, Laubscher TP

Chest. 1994 Dec;106(6):1843-50

PMID 7988211, <http://www.ncbi.nlm.nih.gov/pubmed/7988211>

Design	Prospective open study using ASV during weaning
Patients	27 long-term ventilated ICU patients fulfilling weaning criteria
Objectives	Evaluate ASV in weaning of mechanical ventilation in 3 groups: normal lungs, parenchymal lung disease, and COPD
Main Results	ASV compared to SIMV reduced PS and mandatory rate in patients ready to be extubated. When the PS level was maintained, patients failed weaning.
Conclusion	ASV was useful for indicating weaning readiness, sooner than PS.

Effects of adaptive support ventilation and synchronized intermittent mandatory ventilation on peripheral circulation and blood gas markers of COPD patients with respiratory failure

Han L, Wang Y, Gan Y, Xu L

Cell Biochem Biophys. 2014 Apr;70(1):481-4

PMID 24748176, <http://www.ncbi.nlm.nih.gov/pubmed/24748176>

Design	Prospective cross over study
Patients	86 patients with exacerbation of COPD under invasive ventilation
Objectives	Compare the effects on Vt-RR combination, hemodynamic variables and blood gas analysis, between ASV and SIMV
Main Results	RR, Vt and P _{insp} were decreased during the ASV period compared to SIMV period. Heart rate, systolic and diastolic blood pressure, central venous pressure were decreased during the ASV period. PaO ₂ and pH were increased during ASV period.
Conclusion	ASV delivered more physiologic ventilation improving clinical status in COPD, compared with SIMV
Comment	Data at inclusion are not provided. The period of ventilation were not randomized and SIMV period was always the first one.

Comparison of 3 modes of automated weaning from mechanical ventilation: a bench study

Morato JB, Sakuma MT, Ferreira JC, Caruso P

J Crit Care. 2012 Dec;27(6):741

PMID 22459160, <http://www.ncbi.nlm.nih.gov/pubmed/22459160>

Design	Simulation study
Patients	Lung simulator
Objectives	Compare the weaning performance of ASV, mandatory rate ventilation, and Smartcare
Main Results	ASV correctly recognized weaning success, weaning failure, weaning success with anxiety, weaning success with irregular breathing, and weaning failure with ineffective effort. The 3 modes incorrectly recognized weaning success with Cheynes-Stokes. Time to PEEP stabilization was shorter for ASV (1-2 min for all situations) than for Smartcare (8-78 min). ASV had higher rates of PS oscillations per 5 min (4-15), compared with Smartcare (0-1).
Conclusion	ASV recognized weaning success or failure, except with Cheynes-Stokes, with quick PS stabilization and a high rate of oscillations

Adaptive support ventilation prevents ventilator-induced diaphragmatic dysfunction in piglet: an in vivo and in vitro study

Jung B, Constantin JM, Rossel N, Le Goff C, Sebbane M, Coisel Y, Chanques G, Futier E, Hugon G, Capdevila X, Petrof B, Matecki S, Jaber S

Anesthesiology. 2010 Jun;112(6):1435-43

PMID 20460996, <http://www.ncbi.nlm.nih.gov/pubmed/20460996>

Design	Animal study ASV versus controlled ventilation
Patients	12 anesthetized piglets for 72 h 6/group
Objectives	Compare the effects of ASV with those of controlled ventilation on diaphragmatic dysfunction
Main Results	Controlled ventilation decreased transdiaphragmatic pressure, ASV didn't decrease this pressure. Controlled ventilation was associated with atrophy of the diaphragm, atrophy was not detected in ASV group
Conclusion	ASV maintained diaphragmatic contractile activity, which protects against ventilator-induced diaphragmatic dysfunction

Correlation between the %MinVol setting and work of breathing during adaptive support ventilation in patients with respiratory failure

Wu CP, Lin HI, Perng WC, Yang SH, Chen CW, Huang YC, Huang KL
Respir Care. 2010 Mar;55(3):334-41

PMID 20196884, <http://www.ncbi.nlm.nih.gov/pubmed/20196884>

Design	Prospective interventional study in active patients, with ASV and %MV increased by 10% until mandatory breath delivered
Patients	22 ICU patients on PS
Objectives	Determine the ASV target point TP (delivery of mandatory breath) and measure the work of breathing WOB at %MV TP, %MV TP + 20%, %MV TP - 20%
Main Results	%MV TP was 165% +/- 54% At %MV TP +20% WOB decreased At %VM - 20% WOB increased
Conclusion	In active patients, increasing %MV decreased WOB.

Adaptive support ventilation: an appropriate mechanical ventilation strategy for acute respiratory distress syndrome?

Sulemanji D, Marchese A, Garbarini P, Wysocki M, Kacmarek RM
Anesthesiology. 2009 Oct;111(4):863-70

PMID 19741490, <http://www.ncbi.nlm.nih.gov/pubmed/19741490>

Design	Simulation study ASV versus VC with $V_t = 6$ ml/Kg predictive body weight
Patients	Lung simulator
Objectives	Compared ASV with fixed V_t of 6 ml/kgBW in different scenarios: 60 and 80 kg, PEEP at 8, 12, and 16 cmH ₂ O; MV 120, 150, and 200%
Main Results	In Group I = 60 kg, the number of scenarios with P _{plat} of 28 cmH ₂ O or more was 14 for ASV (26%) and 19 for 6 ml/kg (35%). In group II=80 kg, the number of scenarios PP of 28 cmH ₂ O or more was 10 for ASV (19%) and 21 for 6 ml/kg (39%).
Conclusion	ASV was better able to prevent VILI than fixed V_t by automatically adjusting P _{insp} , sacrificing V_t .

A comparison of adaptive Support Ventilation (ASV) and Conventional Volume-Controlled Ventilation on Respiratory Mechanics in Acute Lung Injury/ARDS

Choi I, Choi J, Hong S, Lim C, Koh Y
Kor J crit Care Med. 2009 Aug; 24(2): 59-63

Design	Prospective crossover study, VC 30 min, then ASV 30 min, then VC 30 min
Patients	13 ARDS
Objectives	Compare respiratory and hemodynamic effects between ASV and VC in ARDS patients
Main Results	During ASV period, Vt increased (373 mL vs 429 mL, $p < 0,05$), RR (22/min vs 19/min, $p < 0,05$) and P _{insp} (32 cmH ₂ O vs 26, $p < 0,05$) decreased compared with VC, without change in arterial blood gases nor in hemodynamic status
Conclusion	ASV was usable in ARDS patients, decreased pressure, and maintained arterial blood gases.

Adaptive support ventilation for gynaecological laparoscopic surgery in Trendelenburg position: bringing ICU modes of mechanical ventilation to the operating room

Lloréns J, Ballester M, Tusman G, Blasco L, García-Fernández J, Jover JL, Belda FJ
Eur J Anaesthesiol. 2009 Feb;26(2):135-9
PMID 19142087, <http://www.ncbi.nlm.nih.gov/pubmed/19142087>

Design	Prospective interventional study during gynaecological laparoscopic surgery
Patients	22 female patients
Objectives	Test the efficacy of ASV to adapt ventilator settings during pneumoperitoneum and Trendelenburg position
Main Results	Compliance decreased and resistance increased during pneumo-trend period, MV was kept constant by an increase in P _{insp} by 3.2 ± 0.9 cmH ₂ O ($p < 0.01$), RR by 1.3 ± 0.5 /min, and T _{insp} /T _{tot} by 43%; these parameters returned toward baseline at final time. PaCO ₂ increased during the pneumoperitoneum (CO ₂ insufflation) and decreased at final time.
Conclusion	ASV adapted ventilator settings to the changes in the respiratory mechanics, keeping MV constant and provided adequate gas exchanges.

Adaptive Support Ventilation as the sole mode of ventilatory support in chronically ventilated patients

Linton DM, Renov G, Lafair J, Vasiliev L, Friedman G

Crit Care Resusc. 2006 Mar;8(1):11-4

PMID 16536713, <http://www.ncbi.nlm.nih.gov/pubmed/16536713>

Design	Prospective observational study %MV was reduced 10% a week, from 90% to 60%
Patients	27 patients chronically ventilated, for at least 3 months prior to admission
Objectives	Describe the outcomes
Main Results	12 patients were weaned within 2 weeks and 2 months. 9 remained in 60% VM. 2 were partially ventilated at home. 4 patients died on ventilation.
Conclusion	ASV was safe in achieving weaning automatically

Adaptive lung ventilation (ALV) during anesthesia for pulmonary surgery: automatic response to transitions to and from one-lung ventilation

Weiler N, Eberle B, Heinrichs W

J Clin Monit Comput. 1998 May;14(4):245-52

PMID 9754613, <http://www.ncbi.nlm.nih.gov/pubmed/9754613>

Design	Prospective observational study ASV during pulmonary surgery
Patients	9 patients during pulmonary surgery and one-lung ventilation
Objectives	Describe the change in respiratory mechanics and the adaptation of ventilatory pattern to and from one-lung ventilation
Main Results	Institution of one-lung ventilation was followed by a reproducible response of the ASV. The sudden changes in respiratory mechanics (resistance increased, compliance decreased but RC was stable) caused a transient reduction in Vt by 42 (8-59)%, with RR unaffected. In order to re-establish the preset MV, the controller increased P _{insp} from 18 (14-23) to 27 (19-39) cmH ₂ O. The controller was effective in maintaining MV.
Conclusion	The ASV controller successfully managed the transition to and from one-lung ventilation.

Continuous use of an adaptive lung ventilation controller in critically ill patients in a multi-disciplinary intensive care unit

Linton D, Brunner J, Laubscher T
Sou Af Med J. 1995 May;85(5): 432-5

Design	Prospective observational study in long-term ventilated ICU patients
Patients	6 ICU patients
Objectives	Evaluate the safety of ASV from initiation to weaning
Main Results	Patients were ventilated for a mean of 51.6 h. PS was maintained at a mean level of 14.8 cmH ₂ O. ASV selected appropriate synchronized pressure support ventilatory pattern from initiation to weaning. It allowed and encouraged spontaneous efforts.
Conclusion	ASV provided clinically acceptable, safe, and effective ventilation during the entire mechanical ventilation period.

Automatic selection of tidal volume, respiratory frequency and minute ventilation in intubated ICU patients as start up procedure for closed-loop controlled ventilation

Laubscher TP, Frutiger A, Fanconi S, Jutzi H, Brunner JX
Int J Clin Monit Comput. 1994 Feb;11(1):19-30
PMID 8195655, <http://www.ncbi.nlm.nih.gov/pubmed/8195655>

Design	Multicenter prospective open study Connection for 1 min for test-breaths
Patients	25 adult ICU patients + 17 critically ill children
Objectives	Test a computerized method for selecting V _t , RR, and MV as startup procedure for closed-loop controlled mechanical ventilation
Main Results	The computerized parameters calculated with test breaths didn't differ from the conventional parameters at the initiation of mechanical ventilation
Conclusion	Automatic selection of ventilation parameters started mechanical ventilation with the same parameters as manual settings .

Additional files

Adaptive support ventilation

Campbell RS, Branson RD, Johannigman JA
Respir Care Clin N Am. 2001 Sep;7(3):425-40
PMID 11517032, <http://www.ncbi.nlm.nih.gov/pubmed/11517032>

Design Original article

Conclusion Explains the ASV principle and the settings.

The work of breathing

Otis AB
Physiol Rev. 1954 Jul;34(3):449-58
PMID 13185751, <http://www.ncbi.nlm.nih.gov/pubmed/13185751>

Design Physiological study

Conclusion Supports the ASV principle of selecting a Vt-RR combination according to the least work of breathing principle.

Automated versus non-automated weaning for reducing the duration of mechanical ventilation for critically ill adults and children

Rose L, Schultz MJ, Cardwell CR, Jouvett P, McAuley DF, Blackwood B
Cochrane Database Syst Rev. 2014 Jun 10;6:CD009235
PMID 24915581, <http://www.ncbi.nlm.nih.gov/pubmed/24915581>

Design	Meta-analysis
Patients	1628 adults ICU patients + 48 critically ill children
Objectives	Compare the duration of weaning from mechanical ventilation, duration of ventilation, ICU and hospital length of stay, mortality, and adverse events between automated closed-loop systems versus nonautomated strategies
Main Results	Closed-loop systems reduced weaning duration in mixed or medical ICU populations, duration of ventilation, and ICU length of stay. There was no difference in mortality rates or hospital stay
Conclusion	Automated closed-loop systems, such as ASV, reduce duration of weaning, ventilation, and ICU stay.

Adaptive support ventilation: State of the art review

Fernández J, Miguelena D, Mulett H, Godoy J, Martínón-Torres F
Indian J Crit Care Med. 2013 Jan;17(1):16-22
PMID 23833471, <http://www.ncbi.nlm.nih.gov/pubmed/23833471>

Design	Review
Conclusion	Discusses ASV, appropriate ventilator settings, advantages, particular effects on oxygenation and ventilation, and monitoring .

Closed loop mechanical ventilation

Wysocki M, Jouvet P, Jaber S

J Clin Monit Comput. 2014 Feb;28(1):49-56

PMID 23564277, <http://www.ncbi.nlm.nih.gov/pubmed/23564277>

Design

Review

Conclusion

Provides overview of technical and engineering considerations regarding closed-loop controlled ventilation.

Hamilton Medical AG

Via Crusch 8, 7402 Bonaduz, Switzerland

 +41 58 610 10 20

info@hamilton-medical.com

www.hamilton-medical.com