

# INTELLiVENT-ASV

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# Fully automated postoperative ventilation in cardiac surgery patients: a randomised clinical trial

De Bie AJR, Neto AS, van Meenen DM, Bouwman AR, Roos AN, Lameijer JR, Korsten EHM, Schultz MJ, Bindels AJGH

Br J Anaesth . 2020 Nov;125(5):739-749

PMID 32739044, <http://www.ncbi.nlm.nih.gov/pubmed/32739044>

<b>Design</b>	Single-centre study, randomized controlled trial
<b>Patients</b>	220 patients at the end of cardiac surgery
<b>Objectives</b>	Compare automated and conventional ventilation regarding the proportion of postoperative ventilation time characterised by exposure to predefined optimal, acceptable, and critical (injurious) ventilatory parameters in the first three postoperative hours
<b>Main Results</b>	Subjects randomised to automated ventilation spent a 29.7% higher mean proportion of postoperative ventilation time receiving optimal postoperative ventilation. Automated ventilation reduced the proportion of postoperative ventilation time that subjects were exposed to injurious ventilatory settings by 2.5%. Severe hypoxaemia was less likely in subjects randomised to automated ventilation (risk ratio: 0.26 [0.22-0.31]). Subjects resumed spontaneous breathing more rapidly when randomised to automated ventilation (hazard ratio: 1.38 [1.05-1.83]).
<b>Conclusion</b>	Fully automated ventilation in patients after cardiac surgery optimised lung-protective ventilation, with fewer episodes of severe hypoxaemia and an accelerated resumption of spontaneous breathing

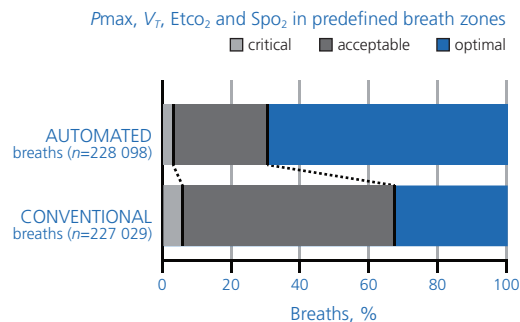


Figure 1: Patients spent more time in optimal and acceptable ranges

# Closed loop ventilation mode in Intensive Care Unit: a randomized controlled clinical trial comparing the numbers of manual ventilator setting changes

Arnal JM, Garnero A, Novotni D, Corno G, Donati SY, Demory D, Quintana G, Ducros L, Laubscher T, Durand-Gasselín J

Minerva Anestesiologica 2018 January;84(1):58-67

PMID 28679200, <http://www.ncbi.nlm.nih.gov/pubmed/28679200>

<b>Design</b>	Randomized controlled study; INTELLiVENT-ASV versus conventional modes (VAC + PSV)
<b>Patients</b>	60 ICU patients with an expected duration of mechanical ventilation of at least 48 hours
<b>Objectives</b>	Compare the number of manual ventilator setting changes, the number of arterial blood gas analyses, the sedation dose and the user acceptance
<b>Main Results</b>	The number of manual ventilator setting changes per 24h per subject was lower in INTELLiVENT-ASV when compared to the conventional ventilation group (5 [4-7] versus 10 [7-17]; $p < 0.001$ ). The number of arterial blood gas analyses and the sedation doses were not significantly different between the groups. Nurses and physicians reported that INTELLiVENT-ASV was significantly easier to use than conventional ventilation.
<b>Conclusion</b>	INTELLiVENT-ASV reduces the number of manual ventilator setting changes with the same number of arterial blood gas analyses and sedation dose, and is easier to use for the caregivers when compared to conventional ventilation modes

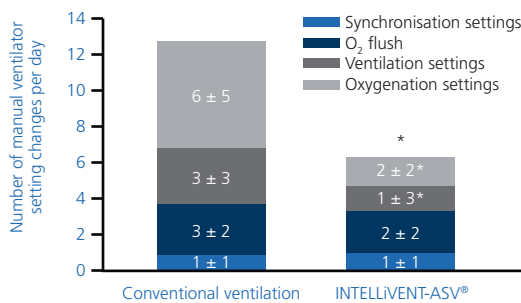
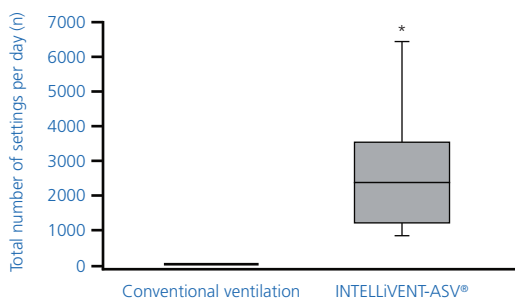


Figure 2: Number of manual ventilator setting changes and total number of ventilator setting changes per day, according to study group



# Automated weaning from mechanical ventilation after off-pump coronary artery bypass grafting

Fot EV, Izotova NN, Yudina AS, Smetkin AA, Kuzkov VV, Kirov MY.

Front Med (Lausanne). 2017 Mar 21;4:31

PMID 28377920, <http://www.ncbi.nlm.nih.gov/pubmed/28377920>

**Design** Randomized controlled study; INTELLiVENT-ASV with Quick Wean function versus protocolized weaning (SIMV + PSV)

**Patients** 40 patients after off-pump coronary artery bypass grafting

**Objectives** Compare duration of mechanical ventilation and assess safety

**Main Results** INTELLiVENT-ASV required a change in settings in 2 patients vs. 7 (5-9) adjustments per patient in the protocolized weaning group. Incidence and duration of unacceptable ventilation were reduced in the INTELLiVENT-ASV group. The FiO<sub>2</sub> during spontaneous breathing trials was significantly lower in the INTELLiVENT-ASV group: 30 (30-35) vs. 40 (40-45)% in the protocolized weaning group. The time until tracheal extubation did not differ between the INTELLiVENT-ASV and the protocolized weaning groups: 193 (115-309) and 197 (158-253) minutes, respectively.

**Conclusion** INTELLiVENT-ASV provides postoperative ventilation in a more protective way, reduces the workload on medical staff, and does not prolong the duration of weaning

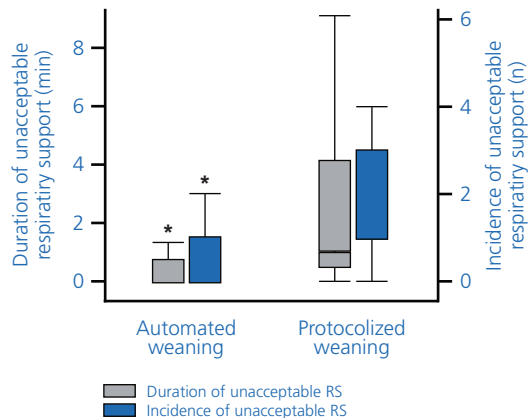


Figure 3: Incidence and duration of unacceptable ventilation were reduced in the INTELLiVENT-ASV group

## Closed-loop ventilation mode (IntelliVent-ASV) in intensive care unit: a randomized trial of ventilation delivered

Bialais E, Wittebole X, Vignaux L, Roeseler J, Wysocki M, Meyer J, Reyckler G, Novotni D, Sottiaux T, Laterre PF, Hantson P

Minerva Anesthesiol. 2016 Jun;82(6):657-68

PMID 26957117, <http://www.ncbi.nlm.nih.gov/pubmed/26957117>

<b>Design</b>	Randomized controlled study, INTELLiVENT-ASV versus VPC and PSV
<b>Patients</b>	80 ICU patients ventilated for at least 48 h
<b>Objectives</b>	Compare safety, efficacy, and workload
<b>Main Results</b>	Ventilation parameters were similar in both groups except for PEEP ( $7 \pm 4$ cmH <sub>2</sub> O vs. $6 \pm 3$ cmH <sub>2</sub> O with INTELLiVENT-ASV and conventional ventilation, respectively, $p = 0.028$ ) and PetCO <sub>2</sub> ( $36 \pm 7$ mmHg with INTELLiVENT-ASV vs. $40 \pm 8$ mmHg with conventional ventilation, $p = 0.041$ ). Safety was similar for INTELLiVENT-ASV and conventional ventilation for all parameters with the exception of Pmax. Efficacy was comparable for the two ventilation strategies for all parameters except SpO <sub>2</sub> and Vt, which were more often optimal with INTELLiVENT-ASV ( $p = 0.005$ , $p = 0.016$ , respectively). INTELLiVENT-ASV required fewer manual adjustments than conventional ventilation ( $p < 0.001$ ) for a higher total number of adjustments ( $p < 0.001$ ).
<b>Conclusion</b>	INTELLiVENT-ASV required fewer manual adjustments than conventional ventilation while delivering safe and effective ventilation

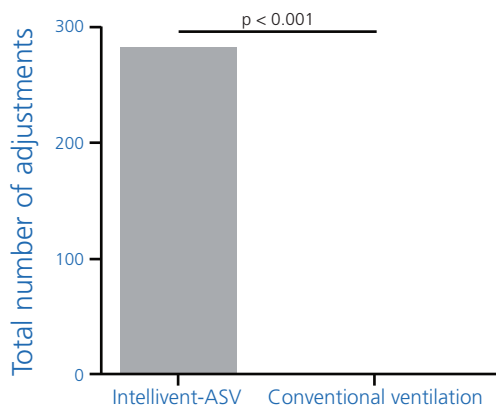


Figure 4: Total number of adjustments including automatic adjustments is higher with INTELLiVENT-ASV

# Evaluation of fully automated ventilation: a randomized controlled study in post-cardiac surgery patients

Lellouche F, Bouchard PA, Simard S, L'Her E, Wysocki M  
Intensive Care Med. 2013 Mar;39(3):463-71  
PMID 23338569, <http://www.ncbi.nlm.nih.gov/pubmed/23338569>

<b>Design</b>	Randomized controlled study, INTELLiVENT-ASV versus VC + PSV
<b>Patients</b>	60 post-cardiac surgery patients
<b>Objectives</b>	Measure the duration of ventilation within a "not acceptable" range of tidal volumes
<b>Main Results</b>	The percentage of time within the predefined zones of optimal, acceptable, and not acceptable ventilation were 12%, 81%, and 7% with PV; and 89.5%, 10%, and 0.5% with INTELLiVENT-ASV ( $p < 0.001$ ). 148 interventions during PV and 5 interventions with INTELLiVENT-ASV ( $p < 0.001$ ).
<b>Conclusion</b>	INTELLiVENT-ASV was safe, reduced the number of interventions, and provided more time in the optimal zone and less time in the not-acceptable zone, in hemodynamically stable patients after cardiac surgery

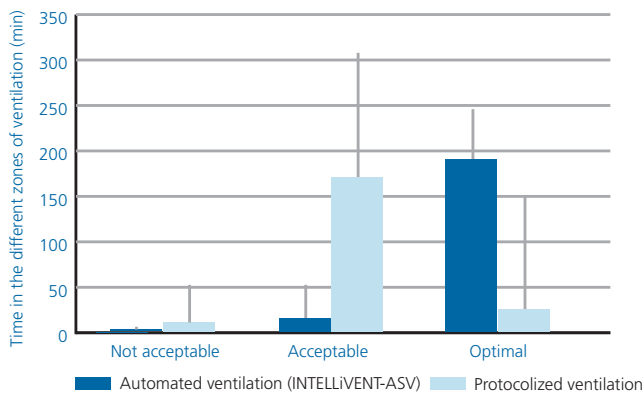


Figure 5: INTELLiVENT-ASV delivered more optimal ventilation than protocolized ventilation. Protocolized ventilation delivered acceptable ventilation.

## Airway and transpulmonary driving pressures and mechanical powers selected by INTELLiVENT-ASV in passive, mechanically ventilated ICU patients

Arnal JM, Saoli M, Garnero A

Heart Lung. 2020 Jul-Aug;49(4):427-434

PMID 31733881, <http://www.ncbi.nlm.nih.gov/pubmed/31733881>

<b>Design</b>	Prospective observational study
<b>Patients</b>	255 adult ICU patients
<b>Objectives</b>	Investigate driving pressure ( $\Delta P$ ) and mechanical power (MP) (and also transpulmonary $\Delta P$ ( $\Delta P_L$ ) and MP (MPL) for a subgroup of patients) delivered by INTELLiVENT-ASV
<b>Main Results</b>	98 patients were classified as normal-lung, 28 as COPD, and 129 as ARDS patients. The median $\Delta P$ was 8 (7-10), 10 (8-12), and 9 (8-11) cmH <sub>2</sub> O for normal-lung, COPD, and ARDS patients, respectively. The median MP was 9.1 (4.9 - 13.5), 11.8 (8.6 - 16.5), and 8.8 (5.6 - 13.8) J/min for normal-lung, COPD, and ARDS patients, respectively. For the 19 patients managed with transpulmonary pressure, $\Delta P_L$ was 6 (4-7) cmH <sub>2</sub> O and MPL was 3.6 (3.1 - 4.4) J/min.
<b>Conclusion</b>	INTELLiVENT-ASV selected $\Delta P$ and MP considered in safe ranges for lung protection. In a subgroup of ARDS patients, the combination of a recruitment strategy and INTELLiVENT-ASV resulted in an apparently safe $\Delta P_L$ and MPL.



## Automated vs. conventional ventilation in the ICU: a randomized controlled crossover trial comparing blood oxygen saturation during daily nursing procedures (I-NURSING)

Chelly J, Mazerand S, Jochmans S, Weyer CM, Pourcine F, Ellrodt O, Thieulot- Rolin N, Serbource-Goguel J, Sy O, Vong LVP, Monchi M

Crit Care. 2020 Jul 22;24(1):453

PMID 32698860, <http://www.ncbi.nlm.nih.gov/pubmed/32698860>

<b>Design</b>	Prospective randomized controlled crossover trial
<b>Patients</b>	265 patients with $FiO_2 \leq 60\%$ and without prone positioning or neuromuscular blocking agents underwent two nursing procedures on the same day using automated (INTELLiVENT-ASV®) and conventional ventilation (VC, BiPAP, or PS) in a randomized order
<b>Objectives</b>	Compare SpO <sub>2</sub> during nursing procedures performed on patients mechanically ventilated in automated and conventional ventilation modes (AV and CV, respectively)
<b>Main Results</b>	The percentage of time spent with SpO <sub>2</sub> in the acceptable range was longer in the automated period than in the conventional period. Automated ventilation was associated with a higher number of nursing procedures carried out with SpO <sub>2</sub> in the acceptable and a lower incidence of blood oxygen desaturation $\leq 85\%$ .
<b>Conclusion</b>	Automated ventilation appears to reduce the incidence and severity of blood oxygen desaturation during nursing procedures in comparison to CV.

# A prospective comparison of the efficacy and safety of fully closed-loop control ventilation (Intellivent-ASV) with conventional ASV and SIMV modes

Abutbul A, Sviri S, Zbedat W, Linton DM, van Heerden PV  
 S Afr J Crit Care. 2014 Aug;30(1):28-32

<b>Design</b>	Prospective crossover study
<b>Patients</b>	20 ICU patients ventilated at least 24h
<b>Objectives</b>	Compares the efficacy of INTELLiVENT-ASV, ASV, and SIMV on ventilation and oxygenation parameters, blood gases, and hemodynamic status
<b>Main Results</b>	INTELLiVENT-ASV automatically selected higher PEEP ( $7.6 \pm 5$ cmH <sub>2</sub> O) than the physician in ASV ( $5.1 \pm 2$ cmH <sub>2</sub> O) and SIMV ( $5.2 \pm 2$ cm H <sub>2</sub> O), lower FiO <sub>2</sub> ( $35 \pm 70$ %) than ASV ( $41 \pm 60\%$ ) and SIMV ( $41 \pm 60\%$ ). There was no difference in RR, Vt, MV, P <sub>insp</sub> , PO <sub>2</sub> , and hemodynamic status. In ASV, PCO <sub>2</sub> levels were lower than in INTELLiVENT-ASV and SIMV.
<b>Conclusion</b>	INTELLiVENT-ASV provides better oxygenation efficiency than ASV and SIMV
<b>Comment</b>	Same PO <sub>2</sub> with lower FiO <sub>2</sub> implies better ventilation/perfusion ratio due to higher PEEP, without hemodynamic consequences

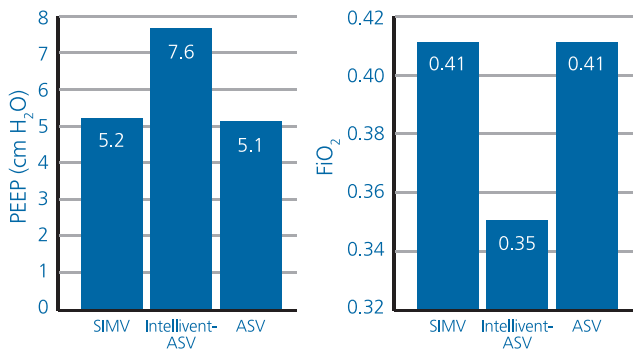


Figure 6: INTELLiVENT-ASV automatically selected higher PEEP and lower FiO<sub>2</sub> than physicians in ASV and SIMV

# Fully automated closed-loop ventilation is safe and effective in post-cardiac surgery patients

Beijers AJ, Roos AN, Bindels AJ

Intensive Care Med. 2014 May;40(5):752-3

PMID 24577110, <http://www.ncbi.nlm.nih.gov/pubmed/24577110>

<b>Design</b>	Prospective comparative non inferiority pilot study
<b>Patients</b>	128 low risk post cardiac surgery patients
<b>Objectives</b>	Compare safety and efficacy between INTELLiVENT-ASV, ASV, and conventional ventilation (PCV and PS)
<b>Main Results</b>	No ventilation-related safety issues. The number of interactions was lower in the INTELLiVENT-ASV group compared to the other groups. Duration of mechanical ventilation, reintubations, and desaturations were not different.
<b>Conclusion</b>	INTELLiVENT-ASV was safe and efficient in post cardiac surgery and required less interactions than conventional modes.

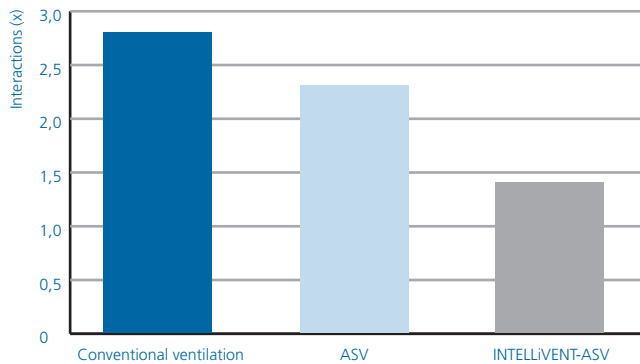


Figure 7: INTELLiVENT-ASV needed fewer manual settings than either ASV or conventional ventilation

# Prospective randomized crossover study of a new closed-loop control system versus pressure support during weaning from mechanical ventilation

Clavieras N, Wysocki M, Coisel Y, Galia F, Conseil M, Chanques G, Jung B, Arnal JM, Matecki S, Molinari N, Jaber S

Anesthesiology. 2013 Sep;119(3):631-41

PMID 23619172 , <http://www.ncbi.nlm.nih.gov/pubmed/23619172>

<b>Design</b>	Prospective, randomized, single-blind crossover study. Two periods of 24 h, randomly PSV or INTELLiVENT-ASV
<b>Patients</b>	14 patients during the weaning phase
<b>Objectives</b>	Evaluate oxygenation and variability in the ventilatory parameters
<b>Main Results</b>	The PaO <sub>2</sub> / FiO <sub>2</sub> ratio improved significantly from 245 ± 75 at baseline to 294 ± 123 after 24 h of INTELLiVENT-ASV. The coefficient of variation of inspiratory pressure and positive end-expiratory pressure were significantly higher with INTELLiVENT-ASV, 16 [11-21] and 15 [7-23]%, compared with 6 [5-7] and 7 [5-10]% in PSV. Inspiratory pressure, positive end-expiratory pressure, and FiO <sub>2</sub> changes were adjusted significantly more often with INTELLiVENT-ASV compared with PSV.
<b>Conclusion</b>	INTELLiVENT-ASV improved oxygenation with more variability than PSV, mainly in P <sub>insp</sub> , PEEP, and FiO <sub>2</sub>

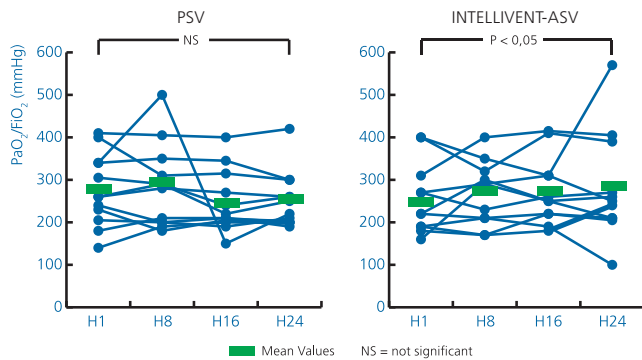


Figure 8: INTELLiVENT-ASV improved oxygenation in actively breathing ICU patients.

## Feasibility study on full closed-loop control ventilation (INTELLiVENT-ASV) in ICU patients with acute respiratory failure: a prospective observational comparative study

Arnal JM, Garnero A, Novotni D, Demory D, Ducros L, Berric A, Donati SY, Corno G, Jaber S, Durand-Gasselín J Crit Care. 2013 Sep 11;17(5):R196

PMID 24025234, <http://www.ncbi.nlm.nih.gov/pubmed/24025234>

<b>Design</b>	Prospective observational comparative feasibility study
<b>Patients</b>	100 unselected ICU patients
<b>Objectives</b>	Compare oxygenation and ventilation settings automatically selected by INTELLiVENT-ASV in 3 lung conditions: normal lungs, ARDS, and COPD, in passive and active patients
<b>Main Results</b>	No safety issues. Fully automated ventilation was used for 95% of the total ventilation time. In passive patients, Vt was significantly different between normal lung, ARDS, and COPD patients, 8.1 (7.3-8.9) ml/kg PBW; 7.5 (6.9-7.9) ml/kg PBW; 9.9 (8.3-11.1) ml/kg PBW, respectively. In passive ARDS patients, FiO2 and PEEP were statistically higher than passive normal lung (35 (33-47)% versus 30 (30-31)%, and 11 (8-13) cmH2O versus 5 (5-6) cmH2O, respectively. The ventilation controller was deactivated in 2 patients for 1 day (increased CO2 gradient). PEEP and FiO2 controllers were deactivated for 1 day in 7 patients because of poor SpO2 quality (5 shocks, 1 therapeutic hypothermia, 1 severe chronic arterial disease). The PEEP controller was deactivated in 3 patients (1 COPD, 1 pneumothorax, and 1 ARDS). The FiO2 controller was deactivated in one COPD patient (hyperoxia).
<b>Conclusion</b>	INTELLiVENT-ASV was safely used in unselected ventilated ICU patients. Automatically selected oxygenation and ventilation settings were different according to the lung condition.

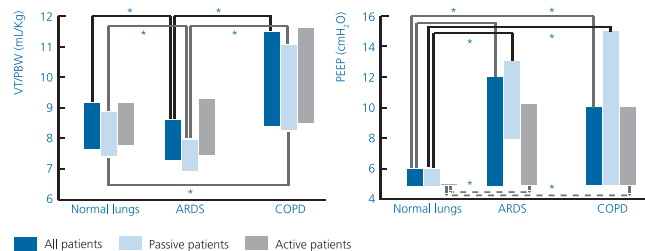


Figure 9: The ventilation parameter Vt was different according to lung condition in the passive patient subgroup. It was not significantly different in the active patient subgroup, as ventilation drive controlled volume and the respiratory rate. The oxygenation parameter PEEP was different according to lung condition in all patients (active and passive).

# Safety and efficacy of a fully closed-loop control ventilation (INTELLiVENT-ASV) in sedated ICU patients with acute respiratory failure: a prospective randomized crossover study

Arnal JM, Wysocki M, Novotni D, Demory D, Lopez R, Donati S, Granier I, Corno G, Durand-Gasselín J

Intensive Care Med. 2012 May;38(5):781-7

PMID 22460854, <http://www.ncbi.nlm.nih.gov/pubmed/22460854>

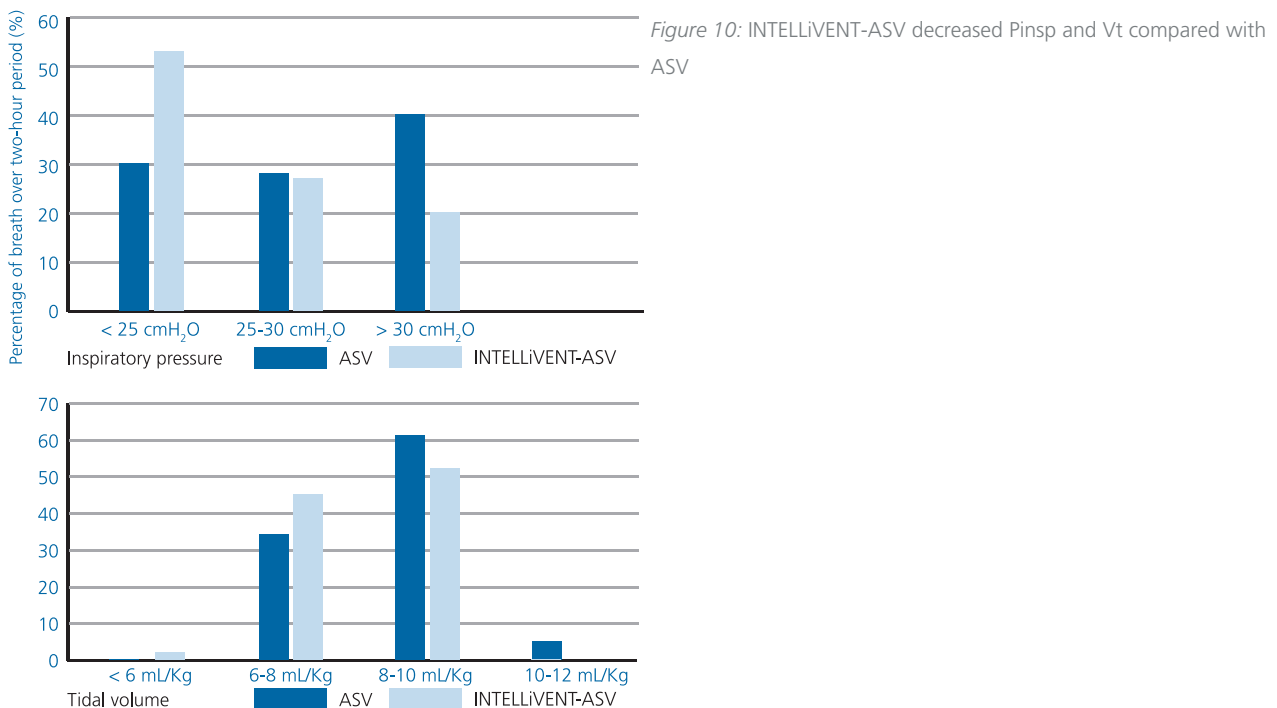
**Design** Prospective randomized crossover comparative study. Two periods of 2 h randomly ASV or INTELLiVENT-ASV

**Patients** 50 sedated ICU patients with ARDS

**Objectives** Assess the safety and efficacy of INTELLiVENT-ASV in passive patients

**Main Results** No safety issue. MV and Vt decreased from 7.6 (6.5-9.5) to 6.8 (6.0-8.0) l/min and from 8.3 (7.8-9.0) to 8.1 (7.7-8.6) ml/kg PBW during INTELLiVENT-ASV as compared to ASV. Pplat and FiO2 decreased from 24 (20-29) to 20 (19-25) cmH2O and from 40 (30-50) to 30 (30-39)% during INTELLiVENT-ASV as compared to ASV. RR, P<sub>insp</sub>, and PEEP decreased during INTELLiVENT-ASV as compared to ASV. Respiratory mechanics and blood gases were not different except for PaCO<sub>2</sub>, which was higher during INTELLiVENT-ASV.

**Conclusion** INTELLiVENT-ASV was safe in passive patients with acute respiratory failure



## Predictive factors for successful INTELLiVENT-ASV® use: a retrospective observational study

Katayama S, Tonai K, Shima J, Koyama K, Nunomiya S

BMC Anesthesiol. 2020 Apr 25;20(1):94

PMID 32334537, <http://www.ncbi.nlm.nih.gov/pubmed/32334537>

<b>Design</b>	Single-center, retrospective observational study
<b>Patients</b>	189 adult ICU patients categorized into the " INTELLiVENT-ASV success" group and " INTELLiVENT-ASV failure" group
<b>Objectives</b>	Report the initial three years of experience using INTELLiVENT-ASV, the clinical conditions; and the technical and organizational factors associated with its use
<b>Main Results</b>	135 patients (71.4%) were categorized into the INTELLiVENT-ASV success group. In the INTELLiVENT-ASV success group, the reasons for ICU admission included post-elective surgery (94.1%), post-emergent surgery (81.5%), and other medical reasons (55.6%). INTELLiVENT-ASV failure was associated with a low P/F ratio and high APACHE II score. The main reasons for not using INTELLiVENT-ASV included strong inspiratory effort and asynchrony.
<b>Conclusion</b>	Most of the ventilated patients could be managed successfully with INTELLiVENT-ASV. During the implementation of INTELLiVENT-ASV, the most severe patients should be excluded until the team is experienced in using it

## A rational framework for selecting modes of ventilation

Mireles-Cabodevila E, Hatipoglu U, Chatburn RL

Respir Care. 2013 Feb;58(2):348-66 Erratum in Respir Care. 2013 Apr;58(4):e51

PMID 22710796, <http://www.ncbi.nlm.nih.gov/pubmed/22710796>

<b>Design</b>	Review
<b>Patients</b>	All ICU patients
<b>Objectives</b>	Describe and compare ventilatory modes
<b>Main Results</b>	INTELLiVENT-ASV is PC-IMV(OI,OI) [order- family(genus, species)]: pressure control, intermittent mandatory ventilation, optimal intelligence for the primary and secondary breaths targeting schemes.
<b>Conclusion</b>	INTELLiVENT-ASV is first among all modes in terms of safety (ventilation and oxygenation optimization), comfort, and weaning

## Adaptive support ventilation with and without end-tidal CO2 closed loop control versus conventional ventilation

Sulemanji DS, Marchese A, Wysocki M, Kacmarek RM

Intensive Care Med. 2013 Apr;39(4):703-10

PMID 23151992, <http://www.ncbi.nlm.nih.gov/pubmed/23151992>

<b>Design</b>	Comparative Simulation study
<b>Patients</b>	Lungs model
<b>Objectives</b>	Compare PC, VC, ASV and ASV with ventilation controller in 4 clinical scenarios : Normal lung, COPD, ARDS and brain injury; with 2 points of interest : capnia and Pplat
<b>Main Results</b>	Ventilation parameters in normal lungs, brain injury, and COPD were similar for all modes. In ARDS, capnia was higher in ASV with the ventilation controller than in other modes, Pplat in ASV and ASV with ventilation controller were lower than in VC.
<b>Conclusion</b>	PC, VC, ASV, and ASV with ventilation controller performed similarly in most cases. In ARDS patients, ASV with ventilation controller delivered safer ventilation.



## A pilot prospective study on closed loop controlled ventilation and oxygenation in ventilated children during the weaning phase.

Jouvet P, Eddington A, Payen V, Bordessoule A, Emeriaud G, Gasco RL, Wysocki M

Crit Care. 2012 May 16;16(3):R85

PMID 22591622, <http://www.ncbi.nlm.nih.gov/pubmed/22591622>

<b>Design</b>	Prospective observational safety study 5 periods : PSV, ASV, ASV with ventilation controller, INTELLiVENT-ASV, PSV.
<b>Patients</b>	15 childrens, more than 7 Kg during the weaning phase
<b>Objectives</b>	Assess the safety by the percentage of time in normal ventilation
<b>Main Results</b>	No adverse events. Vt, RR, P <sub>insp</sub> , and MV were equivalent for all modalities. The percentage of time in normal ventilation were equivalent for all modalities. The PEEP controller needs further investigation.
<b>Conclusion</b>	ASV with ventilation controller and INTELLiVENT-ASV were safe and kept children under normal ventilation most of the time
<b>Comment</b>	The large ranges of normal ventilation in pediatric patients were probably responsible for the similarity between the groups.

# Additional files

## Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and acute respiratory distress syndrome

The Acute Respiratory Distress Syndrome Network

N Engl J Med. 2000 May 4;342(18):1301-8

PMID 10793162, <http://www.ncbi.nlm.nih.gov/pubmed/10793162>

**Design** Multicenter randomized controlled study lower Vt (6 ml/Kg) et Pplat (30 cmH2O) versus traditional Vt (12 mL/Kg) et Pplat (50 cmH2O)

**Patients** 861 patients with ARDS

**Objectives** Compare protective ventilation and traditional ventilation on clinical outcomes

**Main Results** Mortality was lower in the lower Vt group than in the group treated with traditional tidal volumes (31.0 % vs. 39.8 %), and the number of days without ventilator during the first 28 days was greater in this group ( $12 \pm 11$  vs.  $10 \pm 11$ )

**Conclusion** The "ARDSNet table" supports the way in which the oxygenation controller increases PEEP and FiO2

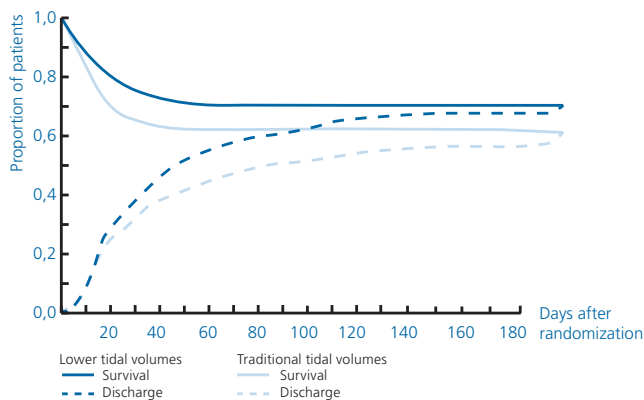


Figure 11: Probability of survival and of discharge were higher in the lower Vt group than in the traditional Vt group.

## Higher versus lower positive end-expiratory pressures in patients with acute respiratory distress syndrome

Brower RG, Lanken PN, MacIntyre N, Matthay MA, Morris A, Ancukiewicz M, Schoenfeld D, Thompson BT; National Heart, Lung, and Blood Institute ARDS Clinical Trials Network

N Engl J Med. 2004 Jul 22;351(4):327-36

PMID 15269312, <http://www.ncbi.nlm.nih.gov/pubmed/15269312>

<b>Design</b>	Randomized controlled study lower versus higher PEEP levels, according to different tables of predetermined combinations of PEEP and FiO <sub>2</sub>
<b>Patients</b>	549 patients with ARDS
<b>Objectives</b>	Compare the effects of higher and lower PEEP levels on clinical outcomes
<b>Main Results</b>	PEEP was 8 cmH <sub>2</sub> O in the lower-PEEP group and 13 cmH <sub>2</sub> O in the higher-PEEP group. Hospital deaths were 24.9% and 27.5%, respectively. From day 1 to day 28, breathing was unassisted for a mean of 14.5 ±10.4 days in the lower-PEEP group and 13.8 ±10.6 days in the higher-PEEP group.
<b>Conclusion</b>	This study supports the high PEEP-FiO <sub>2</sub> table used by the oxygenation controller for decreasing treatment
<b>Comment</b>	PEEP was not set according to recruitability. However, a high PEEP in patients with low potential of recruitability has a negative effect, and low PEEP in patients with high potential of recruitability is harmful.

## Conservative oxygen therapy in mechanically ventilated patients: a pilot before-and-after trial

Suzuki S, Eastwood GM, Glassford NJ, Peck L, Young H, Garcia-Alvarez M, Schneider AG, Bellomo R

Crit Care Med. 2014 Jun;42(6):1414-22

PMID 24561566, <http://www.ncbi.nlm.nih.gov/pubmed/24561566>

<b>Design</b>	Before-After study
<b>Patients</b>	108 ICU patients ventilated for more than 48h
<b>Objectives</b>	Compare 2 oxygenation goals: prescribed by clinician and SpO <sub>2</sub> = 90-92%
<b>Main Results</b>	During period with "SpO <sub>2</sub> = 90-92%", the SpO <sub>2</sub> , PaO <sub>2</sub> , and FiO <sub>2</sub> were lower than during "prescribed goal" (95.5%, 83 torr and, 0.27 versus 98.4%, 107 torr, and 0.40, respectively). "SpO <sub>2</sub> = 90-92%", decreased the total amount of oxygen delivered by two thirds (16 L vs 5 L; p < 0.001). The PaO <sub>2</sub> /FiO <sub>2</sub> ratio was similar during the 2 periods. There were no difference in biochemical or clinical outcomes
<b>Conclusion</b>	Oxygenation goal "SpO <sub>2</sub> = 90-92%" in mechanically ventilated ICU patients was feasible and safe, and decrease the oxygen consumption.

## The dawn of physiological closed-loop ventilation-a review

Platen PV, Pomprapa A, Lachmann B, Leonhardt S

Crit Care. 2020 Mar 29;24(1):121

PMID 32223754, <http://www.ncbi.nlm.nih.gov/pubmed/32223754>

<b>Design</b>	Review
<b>Conclusion</b>	This review shows the evolution of the physiological closed-loop control of mechanical ventilation

## Optimal duration of a sustained inflation recruitment maneuver in ARDS patients

Arnal JM, Paquet J, Wysocki M, Demory D, Donati S, Granier I, Corno G, Durand-Gasselín J  
Intensive Care Med. 2011 Oct;37(10):1588-94  
PMID 21858522, <http://www.ncbi.nlm.nih.gov/pubmed/21858522>

<b>Design</b>	Prospective study
<b>Patients</b>	50 patients with ARDS
<b>Objectives</b>	Measure the dynamics of recruitment and the hemodynamic status during a sustained inflation recruitment maneuver
<b>Main Results</b>	Time constant was $2.3 \pm 1.3$ s = most of recruitment occurred in the first 10 s. Hemodynamic status was maintained for 10 s then decreased significantly.
<b>Conclusion</b>	In early-onset ARDS patients, a sustained inflation RM for 10 s was sufficient and safe. Supports the method used for automatic recruitment maneuver

## Higher vs lower positive end-expiratory pressure in patients with acute lung injury and acute respiratory distress syndrome: systematic review and meta-analysis

Briel M, Meade M, Mercat A, Brower RG, Talmor D, Walter SD, Slutsky AS, Pullenayegum E, Zhou Q, Cook D, Brochard L, Richard JC, Lamontagne F, Bhatnagar N, Stewart TE, Guyatt G  
JAMA. 2010 Mar 3;303(9):865-73  
PMID 20197533, <http://www.ncbi.nlm.nih.gov/pubmed/20197533>

<b>Design</b>	Meta-Analysis
<b>Patients</b>	2299 patients with ARDS 3 trials
<b>Objectives</b>	Evaluate the association of higher vs lower PEEP with patient outcomes
<b>Main Results</b>	Mortality was 32.9% in patients assigned to the higher PEEP group and 35.2% in the lower PEEP group (adjusted relative risk = 0.94; 95% confidence interval [CI], 0.86-1.04)
<b>Conclusion</b>	Higher levels of PEEP were associated with improved survival in ARDS patients. This open-lung concept supports the way in which the oxygenation controller decreases PEEP and FiO <sub>2</sub>

## BTS guideline for emergency oxygen use in adult patients

O'Driscoll BR, Howard LS, Davison AG; British Thoracic Society

Thorax. 2008 Oct;63 Suppl 6:vi1-68

PMID 18838559, <http://www.ncbi.nlm.nih.gov/pubmed/18838559>

<b>Design</b>	Guidelines
<b>Patients</b>	Critically ill patients
<b>Objectives</b>	Summarize the oxygen prescription
<b>Conclusion</b>	Target saturation 94-98% Except for patients with chronic hypercapnia 88-92% Supports the SpO2 target used by the oxygenation controller

## Low mortality rate in adult respiratory distress syndrome using low-volume, pressure-limited ventilation with permissive hypercapnia: a prospective study

Hickling KG, Walsh J, Henderson S, Jackson R

Crit Care Med. 1994 Oct;22(10):1568-78

PMID 7924367, <http://www.ncbi.nlm.nih.gov/pubmed/7924367>

<b>Design</b>	Prospective descriptive study of ventilation management with limitation of peak inspiratory pressure and the use of low tidal volumes
<b>Patients</b>	53 severe ARDS patients
<b>Objectives</b>	Evaluate the outcomes in patients with severe adult respiratory distress syndrome who are managed with reduction of regional lung overdistention and permissive hypercapnia
<b>Main Results</b>	The mean maximum PaCO <sub>2</sub> was 66.5 mmHg (range 38 to 158 mmHg) and the mean arterial pH was 7.23 (range 6.79 to 7.45). The hospital mortality rate was significantly lower than that predicted by the APACHE II scores (26.4% vs. 53.3%, p = .004), even after correcting the latter for the effect of hypercapnic acidosis (26.4% vs. 51.1%). Mortality increased with the number of organ failures: 43% in patients with ≥ 4 failures, 20.5% with ≤ 3 failures, and 6.6% with only respiratory failure.
<b>Conclusion</b>	Supports the permissive hypercapnia concept used by the ventilation controller when P <sub>insp</sub> is above 25 cmH <sub>2</sub> O

## Bench-to-bedside review: hypercapnic acidosis in lung injury: from 'permissive' to 'therapeutic'

Ijland MM, Heunks LM, van der Hoeven JG

Crit Care. 2010;14(6):237

PMID 21067531, <http://www.ncbi.nlm.nih.gov/pubmed/21067531>

<b>Design</b>	Review
<b>Conclusion</b>	Explains the physiopathology and benefits of permissive hypercapnia

## 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

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

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Hamilton Medical AG

Via Crusch 8, 7402 Bonaduz, Switzerland

 +41 58 610 10 20

[info@hamilton-medical.com](mailto:info@hamilton-medical.com)

[www.hamilton-medical.com](http://www.hamilton-medical.com)