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Review Article

Clinical Experiences of the Adaptive Support Ventilation Mode in Cardiac Surgery Patients

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Abstract

Introduction: The Adaptive Support Ventilation (ASV) mode is one of the most advanced ventilation modes. Examining the available scientific texts which analyze the various results of applying this mode, would improve the cardiac surgery patients' conditions undergoing this mode. This study has been accomplished in order to recognize clinical experiences in using this mode in cardiac surgery patients.

Design & setting: In this systematic review data banks such as PubMed, Science Direct, High Wire, Ovid and ProQuest and the Google Scholar searching motor were used. The chosen articles were limited to English language ones. Also the chosen articles were from 1994 to the end of 2013. The used key words were cardiac surgery, ASV, weaning, ICU and clinical experiences.

Participants & Interventions: Based on the relation between the papers and the question of the study and the expert's opinion of the research group, the related papers have been chosen and analyzed.

Measurements and Main Results: Among 105 papers which were found at the end of searching in the data banks, 8 completely related papers were chosen. The only variable that had commonly been considered in all of them was the patients' disconnection time from the mechanical ventilator. The other four variables included intubation time, patients' ICU and hospital stay, sedative requirements and numbers of ABGs.

Conclusions: The results indicate that ASV is a user friendly ventilation mode and can decrease both patients' ICU & hospital stay and health care expenses due to the decreased intubation time. Related studies to this research are limited so this means more considerations in this background are suggested.

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Introduction

The Adaptive Support Ventilation mode (ASV) was designed by Laubscher et al. in 1994 (1, 2) and succeeded in commercial capabilities in 1998 in Europe. It can be said that this mode is one of the most advanced ventilation modes in this regard.

The ASV mode is a form of a minute ventilation mode. This mode has a microprocessor control system and brings forward the patient from ventilation with controlled modes to assist ventilation and then spontaneous ventilation automatically and sets the ventilator on the basis of lung dynamics and patients' breathing effort (3-5). This mode gives slope supportive ventilation including Pressure Controlled Ventilation, Synchronized Intermittent Mandatory Ventilation or Pressure Support Ventilation. This mode also allows the operator to set minV on the basis of ideal body weight . This calculation determines 100% of minV requirements (3).

In this mode, the ventilator monitors the mechanic of the respiratory system continuously and changes its setups upon that (6, 7). In order to prevent hypoventilation, the tidal volume is given more than dead space in this mode and in order to prevent borrow trauma, upper tidal volumes are not given (3, 7). The ventilator set up, automatically ventilators with lung mechanics changes. Less ventilator manipulation by operators and decreasing supportive ventilation are the advantages of this mode (3, 4).

Applying this mode was started in Open Heart Intensive Care Units simultaneously with other units because of its features. Among its reasons, the automatic synchronization of the ventilator with lung mechanic changes and the improvement of the patients' coordination with ventilator can be pointed out.

Methods

Investigation strategy: In this systematic review which considers clinical experiences of the ASV mode in cardiac surgery, all available references were searched in international data banks from 1998 until 2013. For this purpose, English papers on the ASV mode which had complete available text were searched in the internet in PubMed, Science Direct, High, Wire, Ovid and ProQuest database by using ASV Cardiac Surgery, Weaning, ICU and Clinical experiments key words. In order to do this, the first ASV word was searched in each site and then was along with other words. Finally Google Scholar was used for being sure of searching. Non-English papers and the ones that did not have complete texts were excluded from the study. In order to be sure, searching articles was done in these databases independently by the first and second authors and the extracted ones were compared with each other. Among the above mentioned databases, there were 6 papers with complete available texts from PubMed, 9 papers from Science Direct, 7 papers from High Wire and 4 papers from Ovid. Also by considering the references of the papers and searching in Google Scholar 79 papers were added. It should also be mentioned that there was no article in the ProQuest database. Finally there were

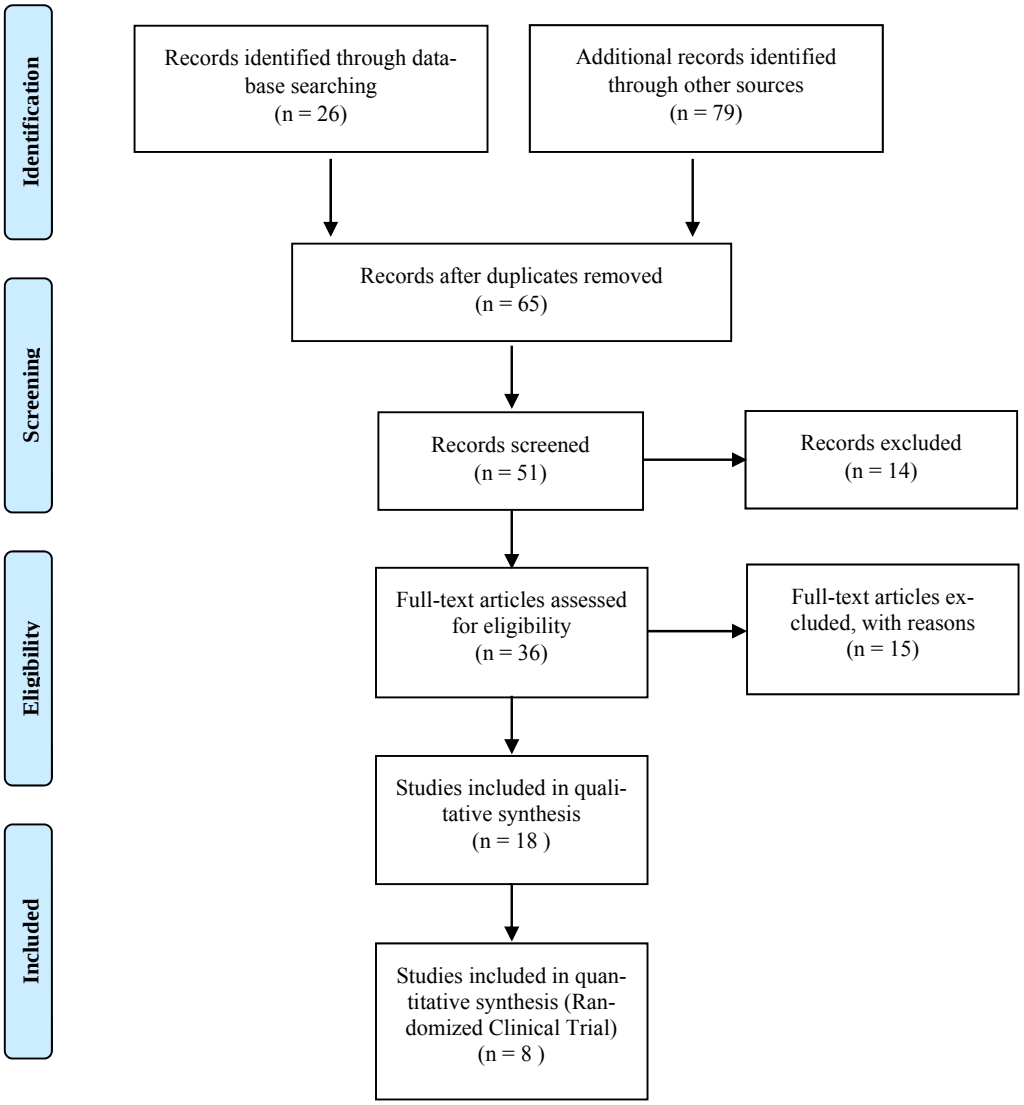
105 papers that 65 of them were related to the topic and among them 18 papers were about cardiac surgery and 8 others were about RCT which were considered in this review study. By investigating the articles, evaluation and analysis of different aspects of the evidences and clinical experiences were done. Also results about using the Adaptive Support Ventilation mode were used (Figure 1)

The databases extraction procedure:

``The members of the inquiry team have discussed about the contents of the papers and analyzed them in several sessions. The important contents of the papers were summarized and classified. The extraction of the texts were done in completely distinctive stages and then classified. Firstly, the important points of each paper were extracted and summarized in a table. The summarized contents were studied distinctively by the members of the team and afterwards were classified in special groups in terms of their concepts.

Finding

As a result, considering the short period of time using the ASV mode, 8 papers from Iran, Netherlands, Switzerland, Taiwan and China have been entered in this study. All these 8 papers have been studied after 2001 (table 1). The only variable that was commonly considered in all the 8 articles, was the time of weaning. Three papers (37.5%) have reported a decrease in the time of weaning from the ASV mode (8-10), but the other 5 papers (62.5%) stated that using this mode of ventilation will not change the time of weaning (4, 11-14).



Other considerations included:

1) Sedative requirements was considered in 3 studies and in all of them (100%) it was explained that the ASV mode would not make any changes in the sedative requirements of patients' in compared to the other ventilation modes (4, 10, 13).

2) In the study of Sulzer et al., the number of ABGs was considered, and the results indicated a decrease in the required times (33.3%)(10). However, Gruber et al. study and

in another study conducted by Aghadavoodi et al., it has been reported that by using this ventilation mode no changes was observed in the number of ABGs (66.6%) (9, 11).
3) In Gruber et al.'s study, different times of manipulating the ventilator by the operators was considered. No changes have been reported by using the ASV mode in compared to the other ventilators modes (100%) (9).
4) In 2 of the 8 studies, results reveal that the time of ICU and hospital stay had decreased (50%) (8). In contrary, the results of Aghadavoodi et al.'s study has revealed that there is no observed changes in the time of ICU and hospital stay (50%) (11). In the study of Aghadavoodi et al. (ASV versus SIMV), other variables such as hemodynamic variables, ventilator and respiratory characteristics were considered effective in the time of the patients' stay in ICU.
The only parameter that was commonly considered in all the 8 studies was the duration of the intubation.

Discussion

In other systematic reviews of accessible related studies, 4 outcomes including decreasing intubation duration, decreasing patients' ICU and hospital stay, decreasing sedative requirements and the number of ABGs have been considered. Intubation time was the only common outcome of all the studies. The results show that ⅓ of the studies indicated a decrease of this time. However, other studies showed no significant difference between this mode and other ventilation modes during the intubation time.
The intubation time is a common concern among therapists and has been a serious challenge during the past few years. The shortage of beds in Intensive Care Units and mechanical ventilation equipment in hospitals, especially in developing countries, have always been important in health care systems (15). This means finding the correct ways to shorten the hospitalization time and patients' **mechanical** ventilation in this unit would be more helpful in decreasing healthcare expenses (16, 17). History shows that since 1960 the patients' have been under mechanical ventilation for one night, due to repeated respiratory complications after cardiovascular surgery (18).

Although, during the recent years, there have been many studies over fast track extubation in order to decrease the pulmonary side effects in CABG . According to these studies, extubation in early 6hours after surgery would decrease respiratory side effects considerably and would improve the patients' cardiac outcomes (5, 19-21).This issue results in faster well-being and rehabilitation and decreases patients' stay in the ICU and hospital (22, 23).Fast track extubation can decrease healthcare expenses to 50% after cardiac surgery. Applying useful anesthetic procedures during operation and also postoperative management can be used for fast track extubation without any specific side effects in patients under Coronary Artery Bypass Grafts surgery (20). Endo tracheal tube can also result in the patients' inability to communicate, increases patients' agitation and causes patients' increasing sedation requirements (24).
According to the survey and the results of this systematic review, intubation time is the most important parameter which can decrease patients' stay in the ICU and hospital, number of ABGs and patients' sedative requirements.

Conclusion

Findings show that ASV is a user friendly ventilation mode and can decrease the health care expenses and patients' ICU and hospital stay by decreasing the intubation time. Although the results are controversial, the studies over this subject are limited and the need for more studies seems to be necessary in this regard.
What is known about this topic?
ASV is a user friendly mode that can help weaning from mechanical ventilation.
ASV has been used in CABG patients in recent years, but its efficacy remains unclear.
What this paper adds?
This study will help to summarize the clinical experiences with ASV in cardiac surgery.
ASV can reduce the mechanical ventilation time and hospital and ICU stay.

Table 1. Table of the features of the entered studies

Author	Case&Control (N)	Intervention	Compared with	Results	Outcomes
Sulzer (2001)	36	Manual adjustment of PSV	Manual adjustment of PSV	ASV duration if intubation was shorter (3.2 h vs 4.1 h,$P < .02$) Fewer arterial blood gases in the ASV group, No difference in sedation requirements	Duration of intubation
Petter (2003)	34	ASV & SIMV & PSV	SIMV, then PSV	No difference between groups (2.7 vs 3.2 h) No difference in sedation Requirements	Duration of intubation
Gruber (2008)	48	ASV & Auto Mode & PRVC & volume Support Ventilation	Auto Mode, PRVC and volume support ventilation	Shorter duration of intubation with ASV (300 min vs 540 min, $P < .05$) No difference in number of blood gases or ventilator manipulations	Duration of intubation
Dongelmans (2009)	121		Subjects were ventilated using PC CMV followed by PSV when spontaneous breathing was initiated	No difference in duration of intubation (16.4 h vs 16.3 h, $P = .97$), No difference in sedation Requirements	Duration of intubation
Dongelmans (2009)	128	forced weaning	ASV with forced weaning versus standard ASV	neither shortens duration and nor does it lead to earlier spontaneous breathing	Time till Extubatio in Post−Cardiac Surgery Patients
Dongelmans (2010)	126		Conventional ASV compared to ASV de-escalation with 10% reductions in % minute volume	No difference in the duration of intubation (10.8 h vs 10.7 h)	Duration of intubation
Chien (2011)	149	ASV	ASV group versus non-ASV group	Shorten duration of Intubation & ventilator Dependent & ICU stay & Hospital stay	Time to extubation readiness ICU stay Hospital stay
Aghadavoudi (2012)	81	ASV & SIMV	SIMV	There were no differences in tracheal intubation and the length of ICU stay, in ABG, Hemodynamic changes, respiratory and ventilator characteristics in both groups during ICU stay.	Duration of intubation, length of ICU stay, changes of ABG, hemodynamic, respiratory and ventilator characteristics

Table 2. table of providing results of the done studies

	Outcome	Number of Article	Decrease	No Difference
1	Intubation time	8	37.5 %	62.5 %
2	Sedation Requirement	3	_	100 %
3	Number of ABG	3	33.3 %	66.6 %
4	ICU & Hospital Stay	2	50 %	50 %
5	Ventilator Manipulations	1	_	100 %
6	Hemodynamic Changes	1	_	100 %
7	Respiratory & Ventilator Characteristics	1	_	100 %

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