



Original Research

Airway Pressure Release Ventilation setting disagreements. A survey of clinicians.

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DOI: 10.5281/zenodo.4271186

Cite: Randhawa S, Sato R, Daoud EG. Airway Pressure Release setting disagreements. A survey of clinicians. J Mech Vent 2020; 1(2):32-38.

Abstract

Background:

Airway pressure release ventilation has been available to clinicians for the last four decades. Unfortunately, its clinical value continues to be debatable. One of the many reasons responsible is the lack of consistency between its settings in clinical practice and research. We hypothesized that clinicians disagree on specific methods when establishing these parameters.

Materials and Methods:

A questionnaire-based survey was developed and sent to clinicians (critical care attending physician, critical care fellows in training and respiratory therapists) in about one hundred different academic hospitals with critical care training program. The survey consisted of ten questions including each of the four major APRV settings: T-High, T-Low, P-High, and P-Low. The survey was anonymous.

Main results:

Amongst the 187 respondents, there were significant disagreements between different categories of clinicians regarding methodology for establishing initial settings of APRV. However, when the responses were analyzed after sub-grouping based on categories of clinicians (Critical care attending physician vs critical care fellows vs respiratory therapists), no significant differences could be found.

Conclusions:

There is no agreement between different categories of clinicians when it comes to the methodology for establishing initial APRV settings. Our study highlights the need for larger clinical trials comparing different approaches to the same which could then be used for establishing scientific guidelines based on best evidence.

Keywords: APRV, survey, T-High, T-Low, P-High, P-Low

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Conflict of interest/Disclosures: None

Funding: None

Introduction

Airway pressure release ventilation (APRV) is a form of open lung ventilation with the first literature description of use in 1987¹ which became commercially available in the mid-1990s. It is a form of pressure-controlled intermittent mandatory ventilation that uses extreme inverse inspiratory to expiratory time (I: E) ratios while allowing unrestricted spontaneous ventilation.²

The benefits of APRV, especially in acute respiratory distress syndrome are numerous and documented before.³ Briefly, the resulting higher mean airway pressure while limiting peak pressures increases alveolar recruitment with the conceptual decrease in risk of barotrauma and ventilator-induced lung injury (VILI) due to decreased alveolar cycling. Patient comfort is reportedly increased. The improvement in oxygenation is attributed to the better aeration of dorsal lung regions (due to spontaneous breathing), decreased V/Q mismatch, and decreased dead-space ventilation. Additional benefits of APRV demonstrated in prior studies include significantly higher cardiac index and urine output; decreased vasopressor requirement; improved splanchnic perfusion; reduced sedation and neuromuscular blocker requirements.

All these benefits would make APRV an ideal choice of ventilation, especially in the difficult to oxygenate patients with severe ARDS. Indeed, APRV has been successfully used as a primary mode or rescue non-conventional mode for many clinical scenarios.

Perhaps, no other mode has been more controversial and scrutinized as APRV. While earlier studies demonstrated significant beneficial outcomes including reduced duration of ventilator dependence and decreased mortality⁴, others have failed to demonstrate the same when comparing APRV with conventional mechanical ventilation^{5,6}. Some studies have even suggested a possible relation between APRV and atelectrauma⁷, with another demonstrating a trend towards worsening mortality in pediatric patients⁸. However, recent data appears to be more promising with improved mortality benefits of APRV. Zhou and colleagues performed a well-controlled study⁹ that showed reduced ventilator dependence, ICU length of stay (LOS) and mortality. Two recent systemic reviews and meta-analysis in

2019^{10,11} have confirmed the mortality benefits and reduced ventilator LOS of this study.

Some of the controversies in these studies arose from the lack of consistency on how APRV was applied.^{3,12,13} Unfortunately, there exist no agreed-upon “guidelines” on different methods of setting APRV with some authors^{2,14,15} having published suggestions on how to initiate, troubleshoot, and wean APRV. These methods have been highlighted in a previous review.³ To add to the controversy, there have been two new methods have been described with regards to setting the T-Low. While one of these methods termed time-controlled adaptive ventilation (TCAV) aims at setting the T-Low automatically to target 75% of the peak expiratory flow¹⁶, the other uses an esophageal balloon manometry to target the T-Low based on end release trans-pulmonary pressure.¹⁷

With our current survey, we aimed to prove the disagreement between clinicians in setting the major four parameters of APRV (P-High, P-Low, T-High, and T-Low)

Materials and Methods

We designed a ten-question anonymous questionnaire and sent it to 100 academic hospitals with critical care medicine training programs. The survey link was sent to the program coordinators of the training programs and the respiratory departments to be distributed to the subjects. The full survey questions are in figure 1. The questions included stating one’s professional role as an attending physician certified in critical care medicine, critical care medicine fellow in training, or registered respiratory therapists, their level of experience with APRV and what do they think of its settings compared to other conventional ventilatory methods. For each of the four major settings (P-High, P-Low, T-High, and T-Low), there were five options on how to set each parameter from A-E (Figure 1). We analyzed each setting in two different ways. First, the total number of responses in each option, and secondly, we compared the responses per the different clinical experiences between attendings, fellows and respiratory therapists.

No IRB application was filled given the survey was anonymous with no subject or institution identifiers.



Figure 1
Sample of the questionnaire

Results

Statistical analysis was performed using the Kruskal-Wallis rank-sum test with the results analyzed in two distinct styles to assess for any variance in responses. We first analyzed the responses from all the participants collectively based on the initially chosen methodology. Subsequently, a sub-group analysis was performed after classifying participants based on

categories as clinicians: attending physicians, fellows, or respiratory therapists.

We received 187 responses, 70 were attendings (37.5%), 44 fellows (23.5%), and 73 respiratory therapists (39%). 11% of responders stated they never use APRV, 37% stated they use it infrequently while 51% stated using it frequently. The results of the analysis are summarized in table 1 and figures 2 & 3.

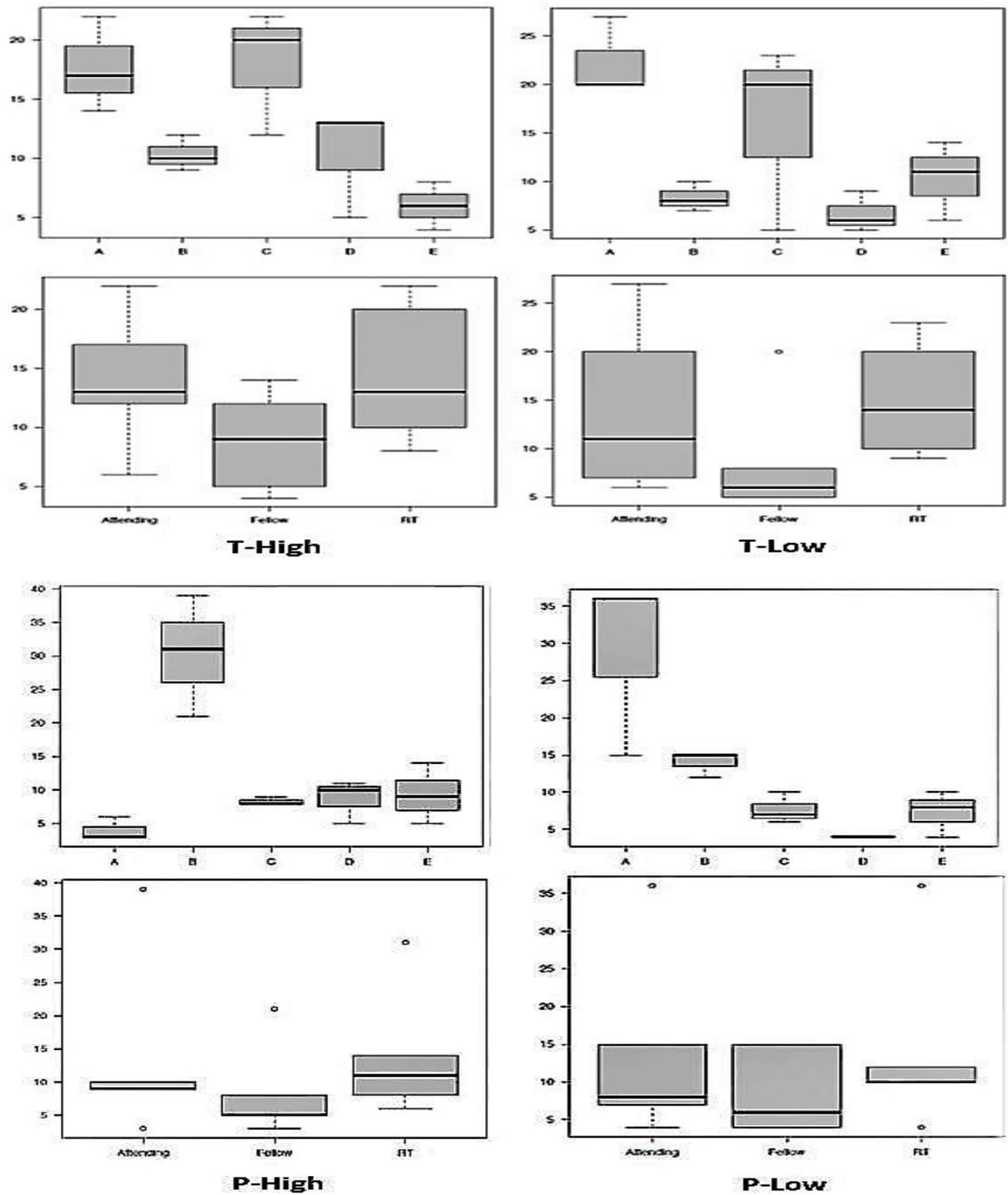


Figure 2
 Plot of the results of each of the 4 questions (T-High, T-Low, P-High, P-Low) first by answer options (A,B,C,D,E) followed by category of experience (attending physician on left, fellow in training in middle, respiratory therapist on left)

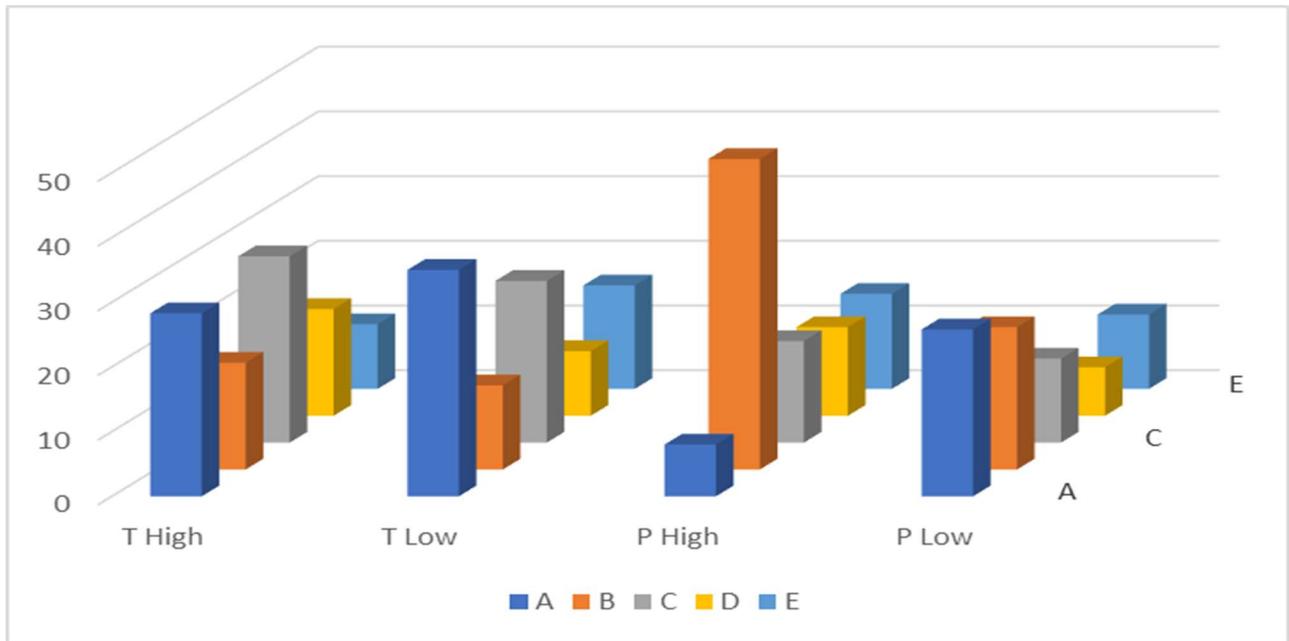


Figure 3
Another representation of the four questions about the initial settings of APRV according to the 5 options for each question

Setting	Responses	P. Value
T-High	All	0.04
	Clinical experience	0.25
T-Low	All	0.02
	Clinical experience	0.14
P-High	All	0.04
	Clinical experience	0.32
P-Low	All	0.02
	Clinical experience	0.75

Table 1
Statistical analysis of the four settings grouped as all responses and between different clinical experience

Discussion

Our results demonstrate that almost 51% of the participants claimed to use APRV frequently, though the frequency was not defined by our questionnaire. They also highlight the lack of agreement between clinicians when choosing the methodology for initial ventilator settings at the time of initiating APRV.

There were no differences between each of the categories of attending physicians, fellows in training and respiratory therapists when a sub-group analysis is performed. This latter finding can be attributed to the level of experience or the small sample size.

Two relatively similar surveys about APRV were conducted in the past but only including respiratory therapists. First one was in 2014 and published only as an abstract,¹⁸ Miller and colleagues surveyed 200 respiratory therapists with 44% response rate. Similar to our findings, 54% claimed to use APRV frequently (more than 20 times per year), but the clinical management seemed to vary (in regard to PEEP levels, I: E ratio, and tidal volumes).

In a second survey published in 2017,¹⁹ the same authors surveyed 60 respiratory therapists regarding the initial settings of APRV. They noted marked differences in all four major settings, especially, T-Low concluding that “There is only limited consensus among practitioners for initial APRV settings, probably reflecting the paucity of good clinical outcome data and confusion surrounding the physiology of this mode”.

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Our study is concordant with the previous two surveys. However, our survey included more participants with physicians included for the first time from a different training background and clinical experiences (attending physicians, fellows in training and respiratory therapists). Some of the comments by our participants called for conformity when applying APRV. Examples include: “settings are very confusing and each ventilator has different names for APRV”, “everyone’s doing it differently, it’s frustrating”, and “why not have guidelines on how to use it by the people who write about it”.

Though our survey has more participants compared to the previously cited ones, it has some limitations and results should be interpreted cautiously. The sample size of 187 is still small and might not represent all clinicians. We surveyed clinicians in academic hospitals with training programs and unclear the results would mirror other participants in non-academic hospitals so sampling method used carries self-selection bias.

We agree with the above comments including the need for scientific evidence-based guidelines and well-controlled trials comparing different methodologies for initial APRV settings are desperately needed. Especially with the new evidence of improved outcomes using APRV, we anticipate increased usage with possibly worsening confusion on how to set initial parameters.

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