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Comparison of the Relationship Between SIMV and PRVC Ventilatory Modes on the Incidence of Asynchrony in Mechanically Ventilated Patients in the Intensive Care Unit: A Randomized Outcome-Assessor-Blinded Study

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Abstract

Aim: Patient–ventilator asynchrony (PVA), commonly occurring in mechanically ventilated patients, is a significant issue that contributes to increased discomfort, prolonged ventilation, and higher mortality rates. Among various ventilatory modes, Synchronized Intermittent Mandatory Ventilation (SIMV) and Pressure Regulated Volume Control (PRVC) are frequently used, yet their comparative effects on PVA remain unclear. This study aims to evaluate and compare the relationship between SIMV and PRVC ventilatory modes and the type and incidence of asynchrony in trauma patients in the ICU.

Study Design: This randomized, outcome-assessor-blinded clinical trial enrolled 100 mechanically ventilated trauma patients in the ICU of a hospital in southern Iran. Patients were randomly assigned to either SIMV or PRVC mode (n=50 in each group). Asynchrony was assessed over a span of 72 hours using standard waveform analysis. The overall incidence of asynchrony was chosen as the primary outcome, while specific types of asynchrony were considered secondary outcomes. Statistical analyses, including t-tests, chi-square tests, and ANOVA, were performed, with a significance level set at $p<0.05$.

Results: Asynchrony was observed in 63% of the patients. Trigger asynchrony was the most prevalent type, affecting 37% of patients. There were no statistically significant associations between the incidence of asynchrony and patient age, gender, or ventilation mode ($p>0.05$). The rates and distribution of asynchrony were similar for both SIMV and PRVC modes.

Conclusions: The significant occurrence of PVA underscores the need for careful, individualized adjustments to ventilator settings. The comparable results obtained with SIMV and PRVC modes suggest that optimizing trigger sensitivity may reduce the impact of mode selection, thus diminishing its importance in clinical decision-making.

Keywords: Intensive care unit; Mechanical ventilation; Patient–ventilator asynchrony; Pressure regulated volume control; Randomized clinical trial; Synchronized intermittent mandatory ventilation; Trigger asynchrony.

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Introduction

In critical care, one of the most essential supportive techniques is mechanical ventilation, which assists patients who are unable to receive sufficient oxygen or eliminate carbon dioxide due to respiratory failure.[1] This therapy is designed to temporarily take over the patient's breathing, allowing the respiratory system to rest and heal, while simultaneously providing oxygen and alleviating some of the pressure on the respiratory muscles.[2] Unfortunately, one of the most significant factors influencing the effectiveness of mechanical ventilation is patient-ventilator asynchrony.

Mechanical ventilation modes reflect technological advancements in flexibility. Synchronized Intermittent Mandatory Ventilation (SIMV) was developed in the 1970s to facilitate patient weaning and quickly became the most common ventilation mode, used in 90.2% of hospitals by the 1980s.[3,4] SIMV combines and synchronizes mandatory and spontaneous breaths. To enhance the clinician's experience, Pressure Regulated Volume Control (PRVC) is a dual-control mode that dynamically adjusts inspiratory pressure to achieve the target tidal volume, adapting to the patient's ventilation needs and lung mechanics with each breath.[5,6]

Patient-ventilator asynchrony is defined as a mismatch between the patient's spontaneous breathing and the ventilator's function. This can occur during the initial phase of breathing, the airflow phase, or the final phase of exhalation.[7] Among critically ill patients receiving mechanical ventilation, the reported prevalence of asynchrony ranges from 10% to 80%.[8] The variation in prevalence is due to differences in assessment methods and the patient populations studied. Data suggest that 25-47% of patients experience severe asynchrony, with an index exceeding 10%.[9]

The clinical implications of patient-ventilator asynchrony are considerable and concerning. Asynchrony can lead to additional strain on the patient's respiratory muscles, increased oxygen consumption, discomfort, anxiety, sleep disturbances, and a greater need for sedation to manage the patient.[10] More severe consequences include prolonged mechanical ventilation, extended ICU stays, ventilator-associated pneumonia, ventilator-induced lung injury, and diaphragm dysfunction—all of which contribute to extended time on mechanical ventilation. Asynchrony also significantly increases patient mortality, particularly in severe cases, with mortality rates as high as 67%, compared to 14% in patients without severe asynchrony.[11]

Several factors contribute to asynchrony, which can be categorized into two broad groups. In terms of device-related issues, the ventilator mode, trigger sensitivity, flow rate, flow rate pattern, and timing of the respiratory cycle are key factors.[12,13] Regarding patient-related factors, the level of consciousness, depth of sedation, comorbid conditions (such as pneumonia and sepsis), smoking history, and medications that exacerbate asynchrony are also important considerations.[14] Research shows that appropriate sedation and the use of certain medications, such as dexmedetomidine, can effectively reduce asynchrony rates.[15]

Few studies have explored the clinical significance of patient-ventilator asynchrony in the southern region of Iran. Therefore, the aim of this study is to determine the degree and type of patient-ventilator asynchrony in this population. Identifying these patterns can form the basis for improving care quality, reducing complications and the duration of mechanical ventilation, and ultimately enhancing patient outcomes.

Materials and Methods

Study Design

This study was a randomized, outcome-assessor-blinded, single-center clinical trial conducted in the intensive care unit (ICU) of a hospital in southern Iran. The goal was to assess the impact of two ventilatory modes—PRVC and SIMV—on patient-ventilator asynchrony in mechanically ventilated multiple trauma patients within the first 72 hours of their care. The study was designed as a parallel-group superiority trial with a 1:1 allocation ratio. The research adhered to the Declaration of Helsinki (2013) and was granted ethical approval from Ethics Committee of Hormozgan University of Medical Sciences (Approval Number: IR.HUMS.REC.1402.054, Date: 31.08.2022). It was also registered in the Iranian Registry of Clinical Trials (ID: IRCT20230702058640N1).

Participant Selection and Enrollment

Of the 105 trauma patients requiring mechanical ventilation, five patients (4.8%) were excluded from randomization due to hemodynamic instability with high-dose vasopressors (n=3) and active pneumothorax (n=2). One hundred patients provided informed consent, and all

were randomly assigned to either the SIMV group (n=50) or the PRVC group (n=50), with a 1:1 allocation ratio.

Inclusion criteria were: trauma ICU patients requiring invasive mechanical ventilation, aged 15-70 years, and with explicit informed consent from the patient or their legal representative.

Exclusion criteria included: hemodynamic instability defined as high-dose vasopressor therapy or a mean arterial pressure of less than 65 mmHg; active pneumothorax; chronic lung diseases (e.g., COPD, severe asthma, pulmonary fibrosis); significant pulmonary contusion or large-scale chest trauma (e.g., flail chest or multiple rib fractures affecting respiratory mechanics); the need for severe or massive fluid resuscitation; open abdomen trauma; death; extubation; withdrawal from the study before completion; review of the patient's records; any type of resuscitation in the last 24 hours; study withdrawal; or issues with the mechanical ventilator.

Ventilator settings and patient management were overseen by intensivists and third-year or higher anesthesiology residents, all with at least 1 year of experience with ventilators. Before the study began, all staff underwent training on the study protocol during educational workshops designed specifically for this purpose (Fig. 1).

Sample Size Calculation

The sample size was calculated to detect a clinically meaningful 10% difference in the mean Asynchrony Index (AI, as a continuous variable), with a standard deviation of 15%. The calculation used the formula for comparing two means, a type I error (α) of 0.05, and a statistical power of 80%, based on the reference methodology by Thille et al.,[16] which is widely accepted for patient-ventilator asynchrony studies. After accounting for a 10% dropout rate, the final sample size was determined to be 50 patients per group, for a total of 100 patients.

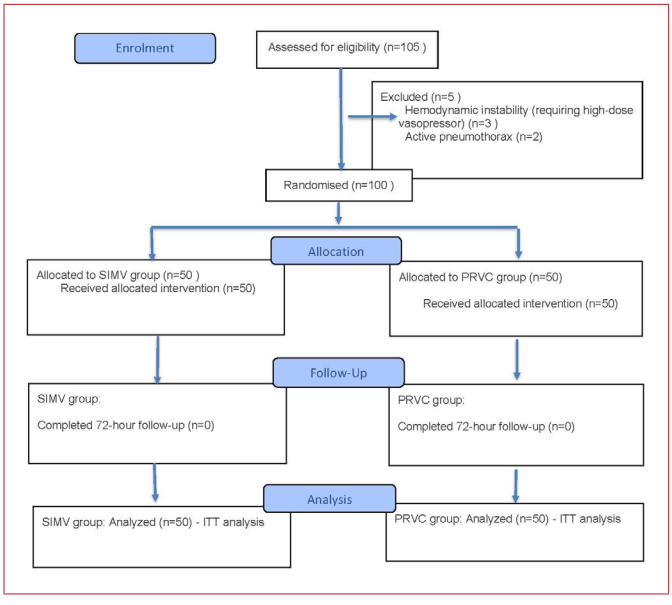

Figure 1. CONSORT 2025 flow diagram.

Randomization, Allocation, and Blinding

An independent statistician performed block randomization with block sizes of 4 and 6, using the Random Allocation Software and stratifying by Injury Severity Score (ISS < 25 vs. ≥ 25). An ICU nurse, who was not involved in the patient's care, opened sealed, opaque, consecutively numbered envelopes to ensure allocation concealment after eligibility was confirmed.

Outcome evaluators and data analysts were blinded to group allocation. Treating clinicians could not be blinded due to the nature of the intervention but were excluded from outcome assessment. Patients were also unaware of their allocation due to sedation and mechanical ventilation.

Interventions

Participants were equipped with standard endotracheal tubes (7.5-8 mm for males; 7-7.5 mm for females) prior to being connected to an Evita 4 mechanical ventilator.

The standard mechanical ventilation parameters were set within the following ranges: 10-15 breaths/min, a tidal volume of 6 mL/kg body weight per breath, 5 cm H2O PEEP, 10 cm H2O pressure support, 2-3 L/min trigger sensitivity, FiO2 adjusted to maintain peripheral oxygen saturation (SpO2) ≥ 92%, and an inspiratory-to-expiratory (I:E) ratio of 1:2 to 1:3.

For the SIMV group, the volume-controlled SIMV mode was used, while the volume-controlled PRVC mode was used for the PRVC group, with an additional upper pressure limit of 35 cm H2O. All other ventilatory settings were as previously described.

No changes were made to the ventilatory settings unless clinically indicated by conditions such as hypoxemia, acidosis, hemodynamic instability, or hypercapnia. Adherence to these conditions was recorded.

All patients received a continuous intravenous midazolam infusion at a rate of 0.06 to 0.15 mg/kg/hr, adjusted as needed to maintain a Richmond Agitation-Sedation Scale (RASS) score of –2 to –3. Fentanyl was adminis-

tered either as a continuous infusion or as needed boluses (1 mcg/kg/hr) for pain control. No neuromuscular blocking agents were used. Average infusion rates and total drug amounts were similar between the SIMV and PRVC groups for both drugs (all comparisons, $p>0.05$).

Study Outcomes

The overall level of patient-ventilator asynchrony and the Asynchrony Index (AI) were assessed during the first three days of mechanical ventilation (MV) using the formula for AI = (number of asynchronous breaths / total number of breaths) × 100. This was the primary measure of patient-ventilator asynchrony (AI) and served as the Primary Outcome of the study.

For the Secondary Outcome, variables were assessed based on the type of asynchrony, classified in accordance with the Consensus Nomenclature:

Trigger Asynchrony: Triggering inefficiency, auto-triggering, and trigger delay.

Asynchrony of Flow/Channel or Vt: Volume asynchrony, target-volumetric consistency, and PRVC-related asynchrony.

Premature or Over-Delayed-Cycling Asynchrony: Asynchrony due to early or delayed cycling of breaths.

Study-specific checklists were used to report mechanical ventilation complications, document instances of barotrauma and hemodynamic instability, identify peak airway pressures > 40 cm H_2O, and record severe asynchrony episodes (AI ≥ 30%).

Data Collection and Asynchrony Detection

Once Institutional Review Board (IRB) approval was granted and informed consent was obtained, clinical and demographic data—including age, sex, and initial ventilator settings—were collected. Asynchrony detection was performed through intermittent waveform sampling, with three 30-minute time slices selected randomly each day (0-24 hours, 24-48 hours, and 48-72 hours), providing 90 minutes of analysis per day. Waveforms were obtained from Respina P1 ventilators (Saadat Co., Tehran, Iran) with a 12.1-inch display monitor resolution of 1280×800. The pressure-time and flow-time waveforms were analyzed with a sweep speed of 10-15 mm/s.

Each breath in the 30-minute file was analyzed breath-by-breath by one of three intensivists with at least five years of experience interpreting ventilator waveforms. No detection software was used to support the analysis. The average number of breaths analyzed per 30-minute recording was 612±78. This study relied on a clearly definable limit. A single observer evaluated each recording to determine inter-observer agreement (kappa), with no defined agreement required. Continuous 24-hour monitoring was performed without interruption.

Asynchrony Classification Criteria

Asynchrony types were classified according to standardized definitions:

Trigger Asynchrony: Including ineffective triggering (visible patient inspiratory effort without ventilator response), auto-triggering (ventilator-initiated breath without patient effort), and double-triggering (two ventilator cycles triggered by a single patient effort), as defined by Blanch et al.[17] and Bruni et al.[18]

Premature/Delayed Cycling: Early termination of mechanical inspiration before the completion of the patient's inspiratory effort (premature cycling) or prolonged mechanical inspiration beyond the patient's neural inspiratory time (delayed cycling), identified by persistent inspiratory flow at the end of the mechanical breath or active expiratory muscle recruitment.[18]

Flow Asynchrony: A mismatch between the patient's inspiratory flow demand and the delivered flow, identified by a concave deformity in the pressure-time waveform during inspiration or a scooped appearance of the flow-time curve.[17,18]

Combined/Multiple Asynchronies: The simultaneous occurrence of two or more asynchrony types within the same breath or recording period.

Each breath was categorized into one of these types based on visual waveform patterns. Due to study design limitations, subtypes within trigger asynchrony (e.g., differentiating ineffective from auto-triggering) were not separately quantified.

Statistical Analysis

Data analysis was performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Quantitative variables with normal distributions were analyzed and compared using independent t-tests. Variables that did not conform to normality were analyzed and compared using Mann-Whitney U tests. Qualitative variables were compared using chi-square and Fisher's exact tests.

Primary outcomes were compared using independent t-tests and repeated-measures ANOVA with Bonferroni post hoc corrections. A p-value of <0.05 was considered statistically significant and used for subsequent analyses.

Intention-to-treat principles were followed during the analytic phase. Listwise deletion was applied for missing data rates of less than 5%, and datasets with higher rates underwent sensitivity analysis. Subgroup analysis was performed based on trauma severity, Injury Severity Score (ISS), age, and time periods.

Use of Artificial Intelligence

The only AI-assisted technology used in this study was for improving the clarity and readability of the manuscript, specifically for editing and grammar checks. All scientific content, including data analysis, interpretation, and conclusions, remains the original work of the authors.

Results

Demographic and Other Descriptive Findings

This study enrolled 100 patients on mechanical ventilation. Of the participants, 65 (65%) were male, and 35 (35%) were female (Table 1), indicating a higher prevalence of males. The SIMV mode of ventilation was the most commonly used, employed in 51 patients (51%), while PRVC was used in 49 patients (49%) (Table 2).

Analysis of asynchrony revealed that 63 patients (63%) experienced patient-ventilator asynchrony, while the remaining 37 patients (37%) did not experience any asynchrony during the entire observation period. This finding highlights a substantial occurrence of asynchrony among mechanically ventilated patients. Among the types of asynchrony, the most common was trigger asynchrony, observed in 37 patients. This was followed, in relative order, by premature/delayed cycling, flow asynchrony, and combined multiple concurrent asynchronies (trigger and cycling) (Table 2).

Main Findings

Age was not significantly associated with the occurrence of patient-ventilator asynchrony. The mean age of patients without asynchrony was 34.57±11.03 years (n=37), compared to 34.90±14.04 years in patients with

Table 2. Frequency distribution of study variables and asynchrony types

Variables	n (%)
Study variables	
Gender	
Male	65 (65)
Female	35 (35)
Ventilation mode	
SIMV	51 (51)
PRVC	49 (49)
Asynchrony presence	
No asynchrony	37 (37)
Asynchrony	63 (63)
Asynchrony types (among all patients, n=100)	
Trigger asynchrony	37 (37)
Premature/Delayed cycling	8 (8)
Flow asynchrony (TARGET)	6 (6)
Combined trigger and flow asynchrony	7 (7)
Combined trigger and cycling asynchrony	2 (2)
Multiple concurrent asynchronies (≥3 types)	5 (5)
No asynchrony	37 (37)

SIMV: Synchronized intermittent mandatory ventilation; PRVC: Pressure regulated volume control.

Table 1. Demographic and clinical characteristics of study patients

Variables	Total patients (n=100)	Without asynchrony (n=37)	With asynchrony (n=63)	p
Age (years) Mean±SD	-	57.34±11.03	34.90±14.04	0.72
Gender, n (%)				0.68
Male	65 (65)	25 (67.5)	40 (63.5)	
Female	35 (35)	12 (32.5)	23 (36.5)	
Ventilation mode, n (%)				0.37
SIMV	51 (51)	21 (56.7)	30 (47.6)	
PRVC	49 (49)	16 (43.3)	33 (52.4)	

SD: Standard deviation; SIMV: Synchronized intermittent mandatory ventilation; PRVC: Pressure regulated volume control.

asynchrony (n=63). There was no statistically significant difference between the two groups (p=0.72), indicating that age does not influence the likelihood of experiencing asynchrony.

In terms of gender distribution, 25 (38.5%) of the asynchrony-free males and 40 (61.5%) of the asynchrony-free females were in the asynchrony-ventilated population. Among females, 12 (34.3%) of the asynchrony-free females were in the asynchrony-ventilated population, while 23 (65.7%) of the females with asynchrony were in the asynchrony-ventilated group. Although both males and females had a higher number of patients with asynchrony, the difference was not significant (p>0.05), suggesting that gender is not a defining characteristic of asynchrony (Table 3).

Regarding ventilation modes, 33 patients with asynchrony (67.3% of the cohort) were on PRVC, while 30 patients (58.8%) were on SIMV mode. These figures suggest that the implementation of SIMV showed comparable asynchrony, and statistical testing revealed no substantial differences (p>0.05). Therefore, the type of ventilatory mode does not appear to significantly influence the incidence of asynchrony.

When analyzing the distribution of asynchrony types across gender, interesting patterns emerged. For males, the most dominant type of asynchrony was trigger asynchrony, with 22 cases (59.5% of males with asynchrony). A comparable pattern was observed for females, where trigger asynchrony accounted for 15 cases (40.5% of females with asynchrony). Other types of asynchrony, such as premature/delayed cycling, target, and combined multiple concurrent asynchronies (trigger and cycling), were less common, with similar distributions across genders. Statistical analysis revealed no significant differences in the distribution of these asynchrony types by gender (p>0.05).

Asynchrony distribution by ventilation mode showed that under PRVC ventilation, trigger asynchrony was the most prevalent, affecting 20 patients (54.1% of PRVC patients with asynchrony). This asynchrony type was also the most prevalent in SIMV mode, affecting 17 patients (45.9% of SIMV patients with asynchrony). Other asynchrony types, including premature/delayed cycling, target, and combined multiple concurrent asynchronies (trigger and cycling), were evenly distributed across the two ventilation modes. The differences between the two modes in terms of asynchrony type distribution were not significant (p=0.1) (Table 4).

This study shows that trigger asynchrony was the most frequent type of asynchrony across all study cohorts, regardless of gender or ventilation mode. This suggests that more focused attention should be given to optimizing trigger sensitivity settings and limits on the ventilator apparatus. Additionally, the absence of significant differences across demographic factors (age, gender, and

Table 3. Asynchrony presence by study variables

Variables	Without asynchrony n (%)	With asynchrony n (%)	p
Gender			**0.68**
Male	25 (67.5%)	40 (63.5%)	
Female	12 (32.5%)	23 (36.5%)	
Ventilation mode			**0.37**
SIMV	21 (56.7%)	30 (47.6%)	
PRVC	16 (43.3%)	33 (52.4%)	

SIMV: Synchronized intermittent mandatory ventilation; PRVC: Pressure regulated volume control.

Table 4. Asynchrony type distribution by study variables

Variables	Premature/ Delayed cycling	Flow asynchrony	Trigger asynchrony	Combined trigger & Flow	Combined trigger & Cycling	Multiple concurrent (≥3 types)	p
Gender							**0.57**
Male	4 (66.6%)	5 (83.3%)	22 (59.5%)	5 (71.4%)	2 (100%)	2 (40%)	
Female	2 (33.4%)	1 (16.7%)	15 (40.5%)	2 (28.6%)	0 (0%)	3 (60%)	
Ventilation mode							**0.1**
SIMV	1 (16.6%)	6 (100%)	17 (45.9%)	3 (42.8%)	1 (50%)	2 (40%)	
PRVC	5 (83.4%)	0 (0%)	20 (54.1%)	4 (57.2%)	1 (50%)	3 (60%)	

SIMV: Synchronized Intermittent Mandatory Ventilation; PRVC: Pressure Regulated Volume Control.

mode of ventilation) indicates that these variables had little impact on asynchrony. Furthermore, all asynchrony types within the studied cohorts showed statistically insignificant differences. A more striking finding was the degree of asynchrony observed in 63% of patients, underscoring the need for careful and active surveillance of asynchrony throughout patient care.

Discussion

In this study, 100 patients on mechanical ventilation were evaluated, and asynchrony was found in 63% of the patients, with the most prevalent form being trigger asynchrony, observed in 37 patients. This was not significantly correlated with the patients' age, sex, or the type of ventilation used (SIMV or PRVC). These findings align with existing literature, although there are differences in asynchrony prevalence, the dominant type of asynchrony, factors influencing asynchrony, and the resulting clinical outcomes.

Blanch et al.,[17] the first prospective study to utilize 24-hour monitoring alongside Better Care software, set the stage for follow-up research. They documented a high prevalence of patient-ventilator asynchrony (PVA) across all hours, with a predominance of ineffective expiratory efforts (IEE), a type of trigger asynchrony. Most notably, they revealed the association between high AI and ICU mortality ($p<0.05$). Our results are consistent in terms of prevalence (>50%), the predominance of trigger asynchrony, and the lack of effect of ventilation mode, although we did not assess mortality. This study continues to be the gold standard for defining AI and continuous monitoring.

In a pediatric population, Mortamet et al.[19] documented that 27% of ventilation time was spent in asynchrony, predominantly due to trigger delays and cycling-off errors. While the population differs, their findings regarding ventilator-free days and the emphasis on trigger events align with ours. Our study demonstrates that PVA occurs across the entire age spectrum and is largely independent of demographic characteristics, a conclusion supported by our findings in the adult population.

In their review of 62 studies, Bruni et al.[18] highlighted the variation in research methods, particularly in the definition of AI. Ineffective efforts and double-triggering were the most common types, and relationships with MV duration, patient comfort, and sleep were identified. However, the relationship with mortality remained unspecified (causal vs. associative). This review aligns with our findings that ventilation mode has no significant effect on asynchrony and emphasizes the need for standardization. Our reported prevalence of 63% is within the upper range of reported values (up to 80%).

Sousa et al.[20,21] (2019, protocol; 2020, results - EPISYNC) conducted a study with a design similar to ours (Better Care, entire MV duration) and reported a median AI of 5.1%, with 22% of patients having AI≥10%. The AI range was predicted by intrinsic PEEP and intrinsic SAPS3 (disease severity), while compliance and airway resistance were not. Assisted modes showed greater asynchrony, which was associated with extubation failure (33% vs. 6%, $p=0.01$) but not with mortality. This study is our closest counterpart: it lacks association with age, gender, or mode; shows the predominance of trigger asynchrony; utilizes continuous monitoring; and assesses clinical outcomes. The difference in prevalence (63% vs. 22% with AI≥10%) can be attributed to differences in the AI calculation (entire duration vs. specific hours) and the definition of "asynchrony presence."

Kyo et al.[15] conducted a meta-analysis of 16 studies and found low-quality evidence linking longer mechanical ventilation (MV) (5.16 days) with increased ICU mortality (OR=2.73) and hospital mortality (OR=1.94) in patients with an Asynchrony Index (AI) ≥10%. The use of pressure-targeted modes, tidal volume adjustment, and sedation with dexmedetomidine were shown to reduce the prevalence of adverse events (PVA). This supports the importance of monitoring and post hoc interventions, in line with our emphasis on optimizing trigger sensitivity. Although no intervention was performed in our study, the lack of a mode effect is consistent with the reduction of PVA observed during pressure-cycled ventilation (PCV) in other studies.

Zhou et al.[14] analyzed PVA in a cohort of 676 patients, the largest to date, reporting a 24% prevalence, with double triggering (13%) and flow starvation (10%) as the most common types of PVA. Risk factors included smoking, pneumonia, sepsis, and ARDS. Use of pressure-targeted ventilation was associated with a reduction in PVA, and a higher PVA count was linked to longer mechanical ventilation duration and fewer hospital-free days. While our study reported a lower prevalence of PVA, these findings align with ours. Although we did not study underlying disease factors, the lack of a mode effect in SIMV/PRVC

ventilation supports Zhou's findings in VC-SIMV. The predominance of trigger/cycle-related events and their reduction with PCV, in correlation with worse outcomes, is consistent with our observations.

There are several limitations in this study that must be acknowledged. The single-center design limits the generalizability of the results. Additionally, the lack of systematic collection of baseline clinical characteristics, such as Injury Severity Score (ISS), APACHE II, height, weight, and arterial blood gas values, limits our understanding of baseline group comparability. This represents a significant methodological gap that should be addressed in future multicenter studies.

We also note that asynchrony was assessed using intermittent sampling of 30-minute periods (90 minutes total over 24 hours), rather than continuous sampling, which may lead to an underestimation of asynchrony. Furthermore, the absence of esophageal pressure monitoring prevented the precise identification of ineffective patient-ventilator interactions. The assessment by a single observer within predefined time periods, without establishing inter-rater reliability, may introduce bias in interpretation.

Another limitation is that asynchrony subtypes were captured as whole categories rather than separately, which likely affects the depth of the comparative analysis with more recent literature. Additionally, certain clinical outcomes (e.g., time on mechanical ventilation, ICU length of stay, and mortality) were not captured, preventing an assessment of the potential clinical impact of asynchrony. Future studies should address continuous monitoring, establish an agreed-upon protocol for baseline data collection, and track clinical outcomes more comprehensively.

Conclusion

In this randomized, outcome-assessor-blinded study, 63% of mechanically ventilated patients experienced patient-ventilator asynchrony, with trigger asynchrony being the most common type. There was no significant relationship between asynchrony and patient age, gender, or ventilation mode (SIMV or PRVC), indicating comparable performance between the two modes. Given the high frequency of asynchrony, we advocate for dynamic, individualized adjustments to trigger sensitivity, enhanced educational efforts to support the recognition of asynchrony patterns, and further research to explore the clinical implications of the corrective actions outlined in this study.

Ethics Committee Approval: Ethics committee approval was obtained from Ethics Committee of Hormozgan University of Medical Sciences (Approval Number: IR.HUMS.REC.1402.054, Date: 31.08.2022).

Informed Consent: Written informed consent was obtained from the patients.

Conflict of Interest: The authors have no conflicts of interest to declare.

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