

Integrative Weaning Index (IWI) a better tool for weaning than Rapid Shallow Breathing Index (RSBI)

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Abstract

Aims: Our study aimed to determine the power of Integrative Weaning Index in predicting the success of spontaneous breathing trial in patients under mechanical ventilation.

Materials and Methods: It was a prospective study on 130 critically ill patients, who were under mechanical ventilation for more than 48 hours in JLN medical college and Hospital, Ajmer, Rajasthan. This study was done over a year.

Results: Among the 130 studied cases, 98(75.4%) had a successful outcome whereas a failure was recorded in the other 32 (24.6%) patients. Given the diagnostic accuracy of this index, the results revealed 97.96% sensitivity, 87.5% specificity, 93.33% positive predictive value (PPV), 96% NPV, and 95.38% accuracy

Conclusion: Integrative weaning index can be used as a predictor of spontaneous breathing trial.

Keywords: Integrative weaning index, predictor, spontaneous breathing trial.

Introduction

Integrative weaning index (IWI) is a novel introduced index for predicting the patients' outcome following weaning. This index is a function of three basic parameters, the lungs capacity, arterial oxygen saturation (PaO₂), respiratory rate, and tidal volume which can be calculated easily and with no need for patient's cooperation based on the following equation: $(Cst, [Static\ compliance\ of\ the\ respiratory\ system]) \times SaO_2 (Arterial\ oxygen\ saturation) / F(Respiratory\ rate) / VT(Tidal\ volume\ ratio)$.^{1,2} Subjective assessment alone proves to be a wrong predictor of weaning outcomes. So an objective parameter is needed which can predict the outcomes of spontaneous breathing trials and one such tool is IWI.³

This indicator can be considered a more objective index compared to the conventional methods, as it considers the function of the cardiovascular system, respiratory system, and the respiratory static compliance simultaneously.⁴ RSBI has been documented to be

efficacious in predicting weaning outcomes.^{5,6} In our study we aimed to compare IWI with RSBI.

Aims and Objectives

Comparison of Integrative Weaning Index with Rapid Shallow Breathing Index.

Materials and Methods

Source of data

The study was conducted in department of general medicine, J.L.N medical college, Ajmer.

The study included 130 critically ill mechanically ventilated patients all above 18 years of age, irrespective of ethnicity or etiology, after admission, clinical examination were carried out and relevant investigation were performed.

The integrative weaning score and rapid shallow breathing index were calculated for all the 130 patients who were fit for spontaneous breathing trial as per the treating physician and then the outcomes of spontaneous breathing trial were compared between the two groups.

Based on the cutoff score of 25, the outcome was compared between those who had IWI score of ≥ 25 , and those with < 25 and based on the cut off of 105 for RSBI, the outcomes were compared between those with score more than and less than 105.

Outcome was either success or failure. Patients were followed up upto 48hours after extubation. The outcome was considered as success if the patient tolerated the SBT and patient was not re-intubated and died in the next 48hours. On the contrary, if patient didn't fit into either of the two then it was considered as a failed outcome

In case of tolerance by the patient, the SBT result was considered as successful.

Inclusion Criteria

Patients over 18 years of age receiving mechanical.

ventilation for at least 48 hours to 3 weeks.

Improvement of the underlying disease, no fever.

PaO₂ $> 90\%$ with an inspired O₂ concentration of < 0.4 and a positive end-expiratory pressure (PEEP) < 8 .

Hemodynamic stability (no use of high-dose vasopressive drugs), readiness for return to spontaneous ventilation, favorable level of consciousness (awake or easily awakeable), and pH > 7.2 .

Exclusion Criteria

Age ≤ 18 years.

Inability to obtain informed consent.

Expected survival < 48 h.

Intracranial hypertension.

Neuromuscular disease, pregnancy.

Hemodynamically unstable patients, or on high-dose vasopressor or inotropes.

Patients with tracheostomy tube, and those who were intubated more than once due to weaning failure.

Methods of Collection of Data

Information was collected through a preformed and pretested proforma from each patient. Qualifying patient underwent frequent monitoring of his/her spO₂, plateau pressure, tidal volume, respiratory rate, peak end expiratory pressure and ABG analysis. Qualifying patient underwent detailed history, clinical examination, biochemical examinations and all other routine investigations & relevant investigations that were helpful in the diagnosis of the patient. Success and failure were on the basis of the Index level of ≥ 25 and < 25 respectively.

Statistical Analysis

The data was coded and entered into Microsoft Excel Spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) windows software program. Descriptive statistics included computation for percentages, means and

standard deviations. The independent t test (for quantitative data within two groups) was used for quantitative comparison of all clinical indicators. Chi-square test and fisher exact test were used for qualitative data whenever two or more than two groups were used to compare. Level of significance was set at $P \leq 0.05$. ROC curve was also calculated for cutoff value for the study. Multivariate regression analysis was also done.

Results:

Table 1: IWI with Outcome

		Outcome		Total	
		F	S		
IWI	<25	N	28	2	30
		%	93.3%	6.7%	100.0%
	≥25	N	4	96	100
		%	4.0%	96.0%	100.0%
Total		N	32	98	130
		%	24.6%	75.4%	100.0%

P value=0.001 (S). Out of 98 patients with a successful outcome, 2 patients had IWI score <25 IWI score while 96 patients had ≥25 IWI score. On comparison, IWI and outcome of the study showed statistically significant results. (p value-0.001)

Table 2: RSBI with outcome

		Outcome		Total	
		F	S		
RSBI	<105	N	4	96	100
		%	4.0%	96.0%	100.0%
	>105	N	28	2	30
		%	93.3%	6.7%	100.0%
Total		N	32	98	130
		%	24.6%	75.4%	100.0%

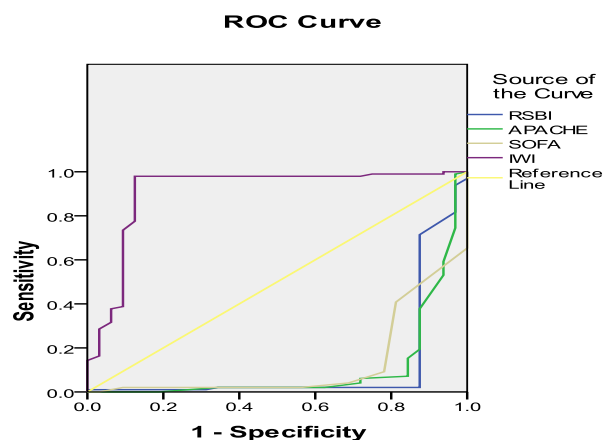
P value=0.001 (S)

Out of 98 patients with a successful outcome, 96 patients had RSBI score <105, while only 2 patients have >105 RSBI score. On comparison, RSBI and outcome of the study showed statistically significant results. (p value-0.001)

Table 3: Outcome and AUC.

	Area Under the Curve	P value
RSBI	0.116	0.001 (S)
APACHE	0.104	0.001 (S)
SOFA	0.128	0.001 (S)
IWI	0.910	0.001 (S)

Graph-1



Diagonal segments are produced by ties.

Area under the curve is 0.116 for RSBI, 0.104 for APACHE, 0.128 for SOFA and 0.910 for IWI. It is significant for all four scores (p value - 0.001 in all four scores)

Table 4: IWI <25, >25 AND RSBI >105, <105

Statistic	Value	95% CI
Sensitivity(IWI)	97.96 %	92.82% to 99.75%
Specificity(IWI)	87.50%	71.01% to 96.49%
Positive	93.33%	77.92% to 98.23%

Predictive Value(IWI)		
Negative Predictive Value(IWI)	96.00 %	90.56% to 98.36%
Accuracy(IWI)	95.38%	90.22% to 98.29%
Statistic (RSBI)	Value	95% CI
Sensitivity(RSBI)	77.78%	69.51% to 84.70%
Specificity(RSBI)	33.33 %	4.33% to 77.72%
Positive Predictive Value(RBSI)	96.08%	93.25% to 97.75%
Negative Predictive Value(RSBI)	6.67 %	2.15% to 18.83%
Accuracy(RSBI)	75.76%	67.53% to 82.79%

Discussion

Given the SBT, among the 130 studied cases, 98(75.4%) had a successful outcome whereas a failure was recorded in the other 32 (24.6%) patients. Our results correspond to those of **Sahar Ebrahimabadi et al**, who described increased failure in cases of patients with an IWI score < 25.⁷

The mean IWI in patients with successful outcome was 58.0 and those with failed outcomes was 22.0 and this difference in IWI between the two groups was found to be statistically significant (p value-0.001). This difference is comparable to the other study done by Viviane MC Boniatti, Márcio M Boniatti, et al.⁸

the findings of the current study showed that IWI as an objective index has higher accuracy in comparison to the other parameters used by physicians in predicting the SBT outcome. This finding is in agreement with

that of several other studies comparing objective protocols with the physician-oriented approach as in the study by **Cenk kirakli, ediboglu et al⁹ and Chaiwat O, Sarima N, Niyompanitpattana K et al.¹⁰**

In our study the area under the ROC curves for IWI was 0.910.

This study was performed to investigate the IWI power in predicting the success and failure of the SBT outcome in patients under mechanical ventilation, hospitalized in Jawaharlal Medical College and Hospital, in 1 year.

Given the findings of the current study and previous reports, it can be concluded that weaning indices which only evaluate one function usually have low accuracy. Therefore, the IWI which can evaluate main functions such as RR-tidal volume ratio, compliance, RR, oxygenation and the CROP index (Compliance, Resistance, Oxygenation, Pressure Index), has higher accuracy and can be considered as a more objective index compared to the indices used by physicians in predicting success or failure.

Conclusion

In our study, the comparison of IWI to current indices showed that IWI had better predictability for weaning patients from mechanical ventilation in the Intensive Care unit and by using this index, intubation and its complications can be reduced. The IWI as a more objective indicator has acceptable accuracy and power for predicting the 2-h SBT result.

Based on our study we can conclude that IWI is *a better predictive performance index of weaning outcome than RSBI*.

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