An anemic patient now is being viewed in light of multi-organ involvement and its impact on other systems too (including but not limited to metabolic) physiology and not respiratory physiology alone. Correction of one physiology might have a decisive impact on other systems too.

Clinical weaning indices designed to predict the weaning potential are most frequently based on pulmonary factors. Vital capacity (VC), inspiratory pressure and minute ventilation have been routinely employed as predictors of weaning outcome. However, many physiological and mechanical factors also have impact on weaning but are often overlooked. The importance of trying to inculcate non-pulmonary variables taken together were also found to significantly affect the positive outcome in total number of patients, significance being 0.001.

For results, we analyzed the 90 patients in 2 groups namely Pulmonary and Non-Pulmonary (45 in each group). The incidence of positive weaning was 77.78% in non-pulmonary groups. The percentage of positive weaning status was maximum in RSBI subgroup (66.7%) in the pulmonary group. There was a significant mean value of composite non-pulmonary score above which a positive outcome could be predicted in both pulmonary and non-pulmonary groups. On regression analysis P/F ratio significantly affected positive outcome on the overall patients, the significance being 0.033. Also, the non-pulmonary variables taken together were also found to significantly affect the positive outcome in total number of patients, significance being 0.001.

Conclusion: On sub-group analysis of pulmonary group, there were non-significant differences between the subgroups with respect to incidence of weaning. Overall incidence of weaning is higher in non-pulmonary group compared to pulmonary group, but the difference is non-significant (p=0.11).

The non-pulmonary variables (composite score) affect significantly the incidence of weaning in pulmonary group.

On whole model (pooled: n=90), regression analysis shows non-pulmonary variables (composite score) and PF ratio are significant contributors to the incidence of weaning while RSBI and Trigger are non-significant; Further, the non-pulmonary variables (composite score) are more significant than PF ratio.

KEYWORDS

P/F = PaO2 / FiO2, RSBI= Rapid Shallow Breathing Index

INTRODUCTION:

This study suggests use of non-pulmonary weaning indices, which assess the influence of factors such as blood albumin and hemoglobin on the weaning success. It is a comparison between pulmonary and non-pulmonary weaning markers and makes an attempt at finding the absolute and relative importance of non non-pulmonary factors in patient outcome in the ICU.

METHODOLOGY:

Design of Study: Prospective, randomized, observational, clinical comparison

After getting approval from Ethical Committee of Motilal Nehru Medical College and associated hospitals, Prayagraj, Uttar Pradesh and obtaining written and informed consent from the patient's representative attendant, the study was conducted in the anesthesia intensive care unit of the department of Anaesthesiology and critical care in the Swarup Rani Nehru Hospital affiliated with Motilal Nehru Medical College, Prayagraj, Uttar Pradesh for a period of one year.

INCLUSION CRITERIA:

- Age- 16-60 years
- Either sex
- Requiring mechanical ventilation

EXCLUSION CRITERIA:

- GCS < 6
- Grossly malnourished
- Severely anemic (Hb gm% < 7)
- Presence of multi organ failure

Patient once given a trial of weaning was not included in the study a second time irrespective of the outcome of the trial.

The patients were randomly divided into 4 groups based on allocation.
of weaning indices.

Coding of indices:

Pulmonary weaning indices

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>P/F Ratio</td>
<td>220-229</td>
<td>230-239</td>
<td>240-249</td>
</tr>
<tr>
<td>B</td>
<td>RSBI</td>
<td>&gt;=125</td>
<td>110-125</td>
<td>100-109</td>
</tr>
<tr>
<td>C</td>
<td>Trigger (cm of H2O)</td>
<td>-1</td>
<td>-1.1 to -3</td>
<td>-3.1 to -5</td>
</tr>
</tbody>
</table>

Non-pulmonary weaning indices

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Serum Hemoglobin</td>
<td>8-8.9</td>
<td>9-9.9</td>
<td>10-10.9</td>
</tr>
<tr>
<td>b</td>
<td>Serum creatinine</td>
<td>&gt;=1.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c</td>
<td>Serum Albumin</td>
<td>1.5-2.49</td>
<td>2.5-3.49</td>
<td>3.5-4.49</td>
</tr>
</tbody>
</table>

Composite score: score (a+b+c) or score (A+B+C)

Low composite score: <=6
High composite score: >6

Groups described, therefore, were as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Score Of Primary Weaning Index Being Applied</th>
<th>Indices From Which Composite Score Would Be Derived For Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gr. 1</td>
<td>P/F Ratio</td>
<td>Hb, Sr. Creatinine, Sr. Albumin</td>
</tr>
<tr>
<td>Gr. 2</td>
<td>RSBI</td>
<td>Hb, Sr. Creatinine, Sr. Albumin</td>
</tr>
<tr>
<td>Gr. 3</td>
<td>Trigger</td>
<td>Hb, Sr. Creatinine, Sr. Albumin</td>
</tr>
<tr>
<td>Gr. 4</td>
<td>Composite Score of Non-Pulmonary Weaning Indices</td>
<td>P/F Ratio, RSBI, Trigger</td>
</tr>
</tbody>
</table>

Group 1, 2, and 3 comprised of 15 patients each while Group 4 comprised of 45 patients.

The method of application of the indices was as follows:
One patient was given a trial of weaning based on the group which the patient had been assigned to randomly. Therefore, a patient could be assigned either P/F ratio or RSBI or Trigger (which are the pulmonary indices) or the composite non-pulmonary weaning index group. Thus, based on this allocation there were a total of 4 groups. Then, if a patient was being weaned off using a pulmonary index e.g. P/F Ratio, the current value of all the pulmonary and non-pulmonary indices of that patient were also noted, given scores as given above and added to give a composite value.

Pulmonary index - composite score of the pulmonary indices calculated

Non-pulmonary index - composite score of non-pulmonary weaning indices calculated

Thus, the outcome of the patient was viewed in light of pulmonary and non-pulmonary weaning indices. Hence, comparison of the two forms of indices was done in each group.

Baseline values for attempting weaning in each group:
Gr 1- P/F ratio >= 238
Gr 2- RSBI <= 115
Gr 3- Trigger <= -2 cm of water
Gr 4- Composite Score >= 8

Weaning was applied only after improvement in basic pathology as indicated by labs and clinically.

Successful weaning was termed as patient being off ventilator for greater than 120 minutes with a normal ABG at 30 minutes, 60 minutes and 120 minutes after discontinuation of ventilator support.

Predictive usefulness of individual criterion was, hence, evaluated and compared in each group.

Observations and Results:

1. Comparison of Demographic Variables in Pulmonary & Non Pulmonary Groups

As shown in Table 1, there were no significant differences in the pulmonary and non-pulmonary groups with respect to age, weight, sex and SOFA score at the time of admission. There were a total of 45 patients in each group. Each group had 31 male and 14 female patients. So there was no difference in the 2 groups with respect to sex of the patient. The mean age of the patients in the pulmonary group was 40.4 years and in non-pulmonary group was 39.38 years. Mean weight of the patients was 57.56 kg in pulmonary group and 59.93 kg in non-pulmonary group. The SOFA score of the patients at the time of admission was 6.11 in pulmonary group and 6.20 in non-pulmonary group. These differences in Age, Weight and SOFA score were found to be statistically insignificant.

Table 1

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Weight (kg)</th>
<th>SOFA score</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.4 ± 13.52</td>
<td>57.56 ± 10.80</td>
<td>6.11 ± 3.44</td>
<td>31 Males + 14 Females</td>
</tr>
</tbody>
</table>

2. Comparison of Incidence of weaning in Pulmonary & Non Pulmonary Groups

Total number of patients in each group was 45. In the pulmonary group, 37 patients were weaned successfully. This was 82.22% of the total patients in the pulmonary group as shown in Table 2. In the non-pulmonary group, a total of 38 patients could be weaned off successfully out of the 45 patients. The incidence of positive weaning was 84.44% in the non-pulmonary group as shown in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Weaning Status</th>
<th>Pulmonary Group</th>
<th>Non Pulmonary Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>27</td>
<td>60%</td>
</tr>
<tr>
<td>Negative</td>
<td>18</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100%</td>
</tr>
</tbody>
</table>

3. Pulmonary Group - Sub Group Analysis

Within the pulmonary group, there were further 3 sub-groups, each subgroup having 15 patients each. The 3 sub-groups were the P/F ratio sub-group, the RSBI sub-group and the Trigger sub-group. Of the 15 patients assigned to each sub-group, 53.3% patients were weaned off successfully in the P/F ratio sub-group, 66.67% patients were weaned off successfully in the RSBI sub-group and 60% patients had a positive outcome in the Trigger sub-group. This showed that the percentage of positive weaning status was maximum in the RSBI subgroup but this difference was statistically insignificant. This has been shown in Table 3.

When the 3 variables of the pulmonary group, i.e P/F ratio, RSBI and Trigger, were compared 2 at a time (e.g. P/F ratio with RSBI) and tabulated, there was no significant difference among the 2 variables taken at a time with respect to weaning status of the patient. This has been depicted in Table 4.
4. Comparison of Pulmonary & Non Pulmonary Variables in Pulmonary Group (n=45)

The impact of the non-pulmonary variables on patients being weaned off on the basis of non-pulmonary variables was calculated and shown in Table 5. As shown in the table, the PF ratio, RSBI and Trigger had no significant mean value above which the patient could be shown to have a positive outcome. However, the composite score of the non-pulmonary variables when calculated in such patients and subjected to statistical analysis revealed that a mean non-pulmonary composite score of 9.13 could be considered significant to influence the positive outcome of the patients.

Comparison of Pulmonary & Non Pulmonary Variables in Non-Pulmonary Group (n=45)

The impact of the pulmonary variables on patients being weaned off on the basis of non-pulmonary variables was calculated and shown in Table 6. As shown in the table, the PF ratio, RSBI and Trigger had no significant mean value above which the patient could be shown to have a positive outcome. However, the composite score of the non-pulmonary variables when calculated in such patients and subjected to statistical analysis revealed that a mean non-pulmonary composite score of 10.60 could be considered significant to influence the positive outcome of the patients.

Regression Equation of whole model (n=90)

The entire data (of 90 patients) was subjected to regression analysis. In this, the aim was to find out if there was any significance of a parameter (pulmonary or non-pulmonary) on the positive outcome of a weaning attempt on a patient. It was seen that the PF ratio significantly affected positive outcome on the total number of patients, the significance being 0.033. Also, the non-pulmonary variables taken together were also found to significantly affect positive outcome on the overall patients, the significance being 0.033. Hence, the need to identify either a single most important marker or a group of markers (pulmonary, non-pulmonary or a combination) that may help in deciding the time when the patient may be given a trial of weaning from the ventilator is imperative. This very quest formed the basis of this study.

Hence, we decided to use certain pulmonary markers of weaning and elicit their individual as well as relative importance in trials of extubation.

The pulmonary markers that were chosen were P/F ratio, RSBI and Trigger. P/F ratio is the ratio of partial pressure of oxygen in the blood and the fraction of oxygen in the air that is being breathed in by the patient. In this study we found that the value of P/F ratio around 200 and above is found to significantly influence the positive outcome of the patient being given a trial of weaning and it was an independent positive predictor in approximately 60% of the patients. Rapid shallow breathing index is a ratio of respiratory rate of the patient and the tidal volume (in liters) delivered/generated. We found that the value of RSBI between 100-110 favors weaning-off of a patient most significantly.

Trigger is a reflector of the strength or ability of the respiratory apparatus of the mechanically ventilated patient to generate a negative intrathoracic pressure that is enough to draw adequate tidal volume. A trigger of -3 cm H₂O or below was seen to relate to a successfully weaned-off patient most of the time and even this parameter was an independent positive predictor in more than 50% patients as was RSBI.

The number of patients in the pulmonary sub-groups that could be weaned off successfully was almost the same (as given in tables) in all the 3 sub-groups and there was no relative advantage of one parameter over the other within the pulmonary sub-group. When the outcome of the patients in the pulmonary group was compared with the outcome in the non-pulmonary sub-group, there was no significant difference among the 2 groups. Hence, there was no clear cut advantage of using non-pulmonary weaning index over pulmonary weaning index and vice-versa which could be attributed to the sample size we worked on. In critically ill patients, malnutrition is associated with impaired immunity, impaired ventilatory drive, and weakened respiratory muscles, leading to prolonged ventilatory dependence and increased morbidity and mortality, reported as being as high as 40%. Recent review papers have documented that nutrition support does influence morbidity and mortality in critically ill patients. Therefore, strategies to improve the delivery of nutrition support are relevant and may result in decreased morbidity and mortality.

Recently, A.S.P.E.N. (American Society of Parenteral and Enteral Nutrition) guidelines were updated to reflect a more current, evidence-based approach to the practice of nutrition support.


Vieira JM Jr, et al (2007) studied effect of acute kidney and concluded that serum creatinine is an important marker of weaning while Sapiaszko MJ, et al (1996) concluded that albumin may be an index of the metabolic status of the patient, which could be important in determining the weanability of the patients. Also, Clochesy JM, et al (1995) highlighted serum albumin as one of the factors that play a determining role in extubation of a patient from mechanical ventilation.

Based on these studies, we decided to evaluate the importance of hemoglobin, serum creatinine and serum albumin as non-pulmonary indices of weaning and also compared the non-pulmonary markers with the pulmonary indices of weaning. In the non-pulmonary group, the number of patients having successful weaning from mechanical ventilation was quite good (35/45).
CONCLUSION:

- In pulmonary group, there were non-significant differences between the sub-groups with respect to incidence of weaning.
- Overall incidence of weaning is higher in non-pulmonary group compared to pulmonary group, but the difference is non-significant (p=0.11).
- The non-pulmonary variables (composite score) affect significantly the incidence of weaning in pulmonary group.
- On whole model (pooled: n=90), regression analysis shows non-pulmonary variables (composite score) and PR ratio are significant contributors to the incidence of weaning while RSBI and Trigger are non-significant; further, the non-pulmonary variables (composite score) are more significant than PR ratio.

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Conflict of Interest: None declared

REFERENCES: