Clinical validation of the signs and symptoms and the nature of the respiratory nursing diagnoses in patients under invasive mechanical ventilation*

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Aims. The aims of this study were to validate the signs and symptoms of the respiratory nursing diagnoses impaired gas exchange, ineffective airway clearance and ineffective breathing pattern in patients under mechanical ventilation; to verify whether intubation time and ventilatory modalities were related factors for respiratory nursing diagnoses; to verify the occurrence of shared signs and symptoms in the diagnoses and compare them with North American Nursing Diagnosis Association’s proposition and to ascertain whether respiratory nursing diagnoses occur in isolated or associated patterns.

Background. The need for mechanical ventilation is common in several patients admitted to intensive care units. Therefore, critical care nurses should identify the respiratory nursing diagnoses of high incidence.

Design and methods. Descriptive observational study, with 177 evaluations of surgical and medical critically ill adult patients undergoing invasive mechanical ventilation. The study adopted Fehring’s Modified Clinical Diagnostic Validity Model, with a suggested alteration.

Results. The critical signs and symptoms were the same as proposed by North American Nursing Diagnosis Association, when the diagnoses were separately identified, although no particular sign and symptom was found for ineffective breathing pattern. Impaired gas exchange and ineffective airway clearance were

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identified as having 88 (49.7%) evaluations sharing the critical signs and symptoms. Intubation time and ventilation modality were related factors for the development of ineffective airway clearance and ineffective breathing pattern.

**Conclusion.** The critical signs and symptoms of impaired gas exchange were abnormal blood gases and hypoxemia. For ineffective airway clearance, they were rhonchi and decreased breath sounds. No highlights were found for ineffective breathing pattern signs and symptoms. Validation by experts has confirmed these findings. The interface between ineffective airway clearance and impaired gas exchange was confirmed by the presence of the shared critical signs and symptoms.

**Relevance to clinical practice.** Studies like this are relevant to clinical practice because they evaluate the adequacy of Taxonomy II for patients under mechanical ventilation in clinical practice, thus allowing for the intensive care nurses to go from one mechanical and routine practice to a critical, reflexive practice, committed to professional progress.

**Key words:** critical care, diagnosis, intensive care, nursing, respiration, ventilation

**Introduction**

The need for ventilatory therapy is very common among critically ill patients (Zeitoun 2001). When invasive mechanical ventilation (MV) is started, the main objective is to relieve the patient’s respiratory effort.

Although MV end expiratory positive pressure and high levels of oxygen therapy (> 50%) can improve ventilation, they are extremely damaging to the lung parenchyma. This damage further incites the inflammatory/immune response and exacerbates ventilation/perfusion mismatch (Huddleston 1990).

When a patient is admitted to an Intensive Care Unit (ICU), nurses must focus their attention on identifying highly occurring nursing diagnoses, because during the critical illness phase the main objective is to establish the physiological process (Gordon 1994).

The respiratory nursing diagnoses (RND) Impaired Gas Exchange (IGE), Ineffective Airway Clearance (IAC) and Ineffective Breathing Pattern (IBP) are three of five RNDs that belong to the North American Nursing Diagnoses Association’s Classification (North American Nursing Diagnosis Association 2003–2004). Through a literature review, we noticed the existence of a high prevalence of studies of these RNDs, possibly because they describe a problem which several surgical and medical patients are at risk of developing due to chronic or acute disease. Bed immobilization, common in intubated and critically ill patients, probably also contributes to the development of these respiratory problems that, in most cases, are interconnected, although they can also occur in isolation. This is exemplified by Titler and Alpen (1999), who explain that patients with IAC related to drainage retention can present an ineffective ventilation and thus, associated IGE.

After an extensive bibliographic research, we found several studies about these RNDs, but none contemplating this specific patient population. Considering NANDA (2003–2004) as the main reference for RNDs development, our initial impression was that there are signs and symptoms (S&S) that were not identified in patients under MV. Therefore, based on what kind of evidence have intensive care nurses identified RND in these patients?

Keeping in mind that critical care nurses must know how to intervene quickly to help critically ill patients with respiratory problems, since their natural defenses are suppressed, we have carried out this study with the following objectives:

- To validate clinically IGE, IAC and IBP S&S in patients undergoing MV.
- To verify whether specific conditions like intubation time and ventilator modality can contribute to an RND presence.
- To verify the occurrence of shared S&S in the RNDs and compare them with NANDA’s proposition.
- To verify whether the RND occurs in an isolated or associated pattern.

**Methods**

**Design and sample**

A descriptive observational study in which 177 evaluations of 38 adult patients were collected in the General and Pneumology Intensive Care Units of Hospital São Paulo, Federal University of São Paulo City, Brazil. Surgical and medical adult patients undergoing invasive MV were
included in the study. The appropriate ethics committees have approved the study. Either a family member or a significant other has signed the consent form. Fehring's (1987) Modified Clinical Diagnostic Validity Model was adopted. This study was developed along three methodological stages.

First methodological stage

(A) Definition of each RND and selection of the S&S based on NANDA’s (2003–2004) Taxonomy II. The IGE definition means excess or deficit oxygenation and/or carbon dioxide elimination at the alveolar-capillary membrane. It has a list of 20 S&S, but we have selected only those that could be evaluated in the specific patients’ sample of this research. Some S&S were also clustered, mainly the redundant and excluded ones; only nine S&S remained (Table 1). IAC definition is inability to clear drainage or obstructions from the respiratory tract to maintain a patent airway. According to this, nine S&S were kept (Table 1). IBP definition is inspiration and/or expiration that do not provide adequate ventilation. According to this, nine S&S remained (Table 1).

(B) Development of conceptual and operational definitions for each S&S and submission to consensual validation by experts. The definitions were developed based on the literature and an intensity degree score was created for each S&S to make them more precise when data were collected:
- 0: absent; 1: light; 2: moderate and 3: intensified (for S&S to which we can apply an intensity degree).
- 0: absent and 1: present (for S&S that already have predetermined value).

NANDA’s (2003–2004) description of S&S was used, as follows: critical, if necessary to be present to identify the diagnosis; major, if it is usually present when the diagnosis exist, and minor, if it supports the diagnosis but cannot be present.

Gordon (1994) explains that the critical S&S are less numerous compared with those that support the diagnoses and they are almost always observed when the diagnoses are present. In turn, the S&S that support the diagnoses have double usage. The first is that the problem is not often evident, although some cues are present. The second usage is when one checks whether the patient’s report can be confirmed by observations and/or nursing research to support the data.

Afterwards, these definitions were submitted to consensual validation by five experts: a pneumologist and a critical care physician, a physical therapist, a nurse with a mastera degree and one with doctoral degree, in addition to some experience in respiratory diagnoses.

Second methodological stage

The data collection tool was developed with demographic data; medical diagnoses and patients’ personal background. Additional data collected were intubation time (to verify whether it can precipitate an RND); ventilator modality (to verify its influence on an RND presence); Glasgow and Ramsay scales for patients in coma and under sedation, respectively (bearing in mind the constraints to investigate some S&S, such as restlessness).

Third methodological stage

The agreement between two pneumologist expert nurses and the researcher were analysed concerning the identification of IGE, IAC and IBP. To guarantee the anonymity they were named experts A and B. The RND developed during data collection was erased in order to not influence the experts’ evaluation. Copies of the original evaluations were made and given to each specialist, together with the final version of the conceptual and operational definition of each S&S; 20 days was the time given to respond.

Data analysis

Mann–Whitney U-test was used to compare the quantitative variables of patients with an RND vs. those without an RND. Chi-square test (with Fisher’s correction when indicated) was
used to investigate the association between two qualitative variables, along with standardized residual analysis, when the chi-square or Fisher’s test showed significant association between variables. Kappa was used to describe the agreement among the appraisers, where 0 means no agreement and 1 means total agreement (100%). Kappa of 0.7 means high agreement, and 0.4–0.6 means medium agreement (Siegel & Castellan 1988, Armitrage & Berry 1994).

**Results**

For the 177 evaluations the intubation mean time was 16 days. Mann–Whitney test revealed that time was longer for patients with IAC, a mean of 17 in relation to those without IAC, a mean of 5 (p = 0.006). It was also longer for patients with IBP, a mean of 25 in relation to those without IBP, a mean of 12 (p < 0.001).

Out of the 177 evaluations made, 59 patients were in coma, with a mean score of 7 on the Glasgow scale. Ramsay scale was applied to 118 patients with a mean score of 4. ‘Restlessness’ has not occurred in any evaluation which, in general, means that patients were in a certain degree of sedation or coma.

Nine ventilation modalities were recorded during data collection. However, to facilitate the interpretation of the results, we have chosen to ignore whether the patient was being ventilated under pressure (P) or volume (V). Thus, only five ventilation modalities remained: SIMV (V or P); AC (V or P); PC or VC; CPAP, PSV.

With chi-square test, there was no statistical significance when the possibility of association of these ventilation modalities with the presence of IGE was analyzed (p = 0.488) and IAC (p = 0.350). However, there was a significant association between ventilation mode and IBP presence (p < 0.001). To identify the ventilation modes which show a true relationship with IBP, it was our choice to carry out the patterned residue analysis, that showed that patients undergoing PSV ventilation mode developed such diagnosis more frequently.

IAC (n = 21) was the diagnosis identified with higher frequency but, in most cases associated with IGE (n = 88), or IAC associated with IGE and IBP (n = 57). Besides, IAC was the diagnosis most often identified as occurring in isolation (11.9%) (Table 2). As some S&S were classified as dichotomous (present or absent, e.g. tachycardia), and to others it was assigned an intensity degree (e.g. rhonchi), they were divided into two groups. (For a better understanding, see Table 3 which shows this distribution.)

To put the major results together, a table which describes the proportion and frequency of the S&S found for each RND, either separated or associated, was developed. For example, when the patient had IGE, the occurrence of abnormal arterial blood gases was 100%; when IGE was associated with IAC and IBP, this percentage falls to 84.2% (Table 4).

The S&S that was prominent regarding the RNDs, either identified as isolated or associated ones, were abnormal blood gases and hypoxemia, followed by tachycardia. These S&S belong to those which define IGE, according to NANDA’s Taxonomy II. Rhonchi showed the greatest frequency, followed by decreased breath sounds, which belong to IAC, according to the same taxonomy. Abnormal breathing rate, which has also showed a significant occurrence, is an S&S shared by the three RNDs.

Altered chest excursion, increased anterior-posterior diameter and diaphoresis were not been identified in any evaluation, which can indicate that they are not relevant for the identification of any RND in patients undergoing MV.

**Description of patients with IGE associated or not with other RND**

In the descriptive statistics carried out along this phase of the study, all the S&S identified to develop the three RNDs were
clustered, with special attention to discovering whether some S&S could be present in other RND, besides those indicated by Taxonomy II.

The S&S identified with higher frequency in patients with IGE were the same identified in the total sample: abnormal arterial blood gases (91.0%), hypoxemia (67.1%), rhonchi (54.2%), always at moderate and great intensity degree, and decreased breath sounds (41.2%) at light, moderate and great intensity. Tachycardia (35.5%) and abnormal breathing rate (29.0%) were present with less significance. The latter was shared by the three RNDs, according to Taxonomy II.

Description of patients with IAC associated or not with other respiratory nursing diagnoses

When all the S&S of the three RNDs were clustered, it was noticed a strong association between the S&S of IAC and IGE was seen.

In the evaluations of patients with IAC, the predominant S&S were abnormal arterial blood gases (78.4%), hypoxemia (58.7%), rhonchi (58.1%), always at moderate and great intensity degree, and decreased breath sounds (45.6%), at light, moderate and great intensity degree. Tachycardia (32.9%) and abnormal breathing rate (26.9%) were less present.

Description of patients with ineffective breathing pattern associated or not with other respiratory nursing diagnoses

When all the S&S were clustered, the prevalent S&S for IBP were abnormal blood gases (82.8%), abnormal breathing rate (77.6%), hypoxemia (62.1%) and rhonchi (58.9%).

No S&S stood out as exclusive of IBP, due to its occurrence always being associated with other RNDs. Abnormal blood gases and hypoxemia belong to IGE; rhonchi belongs to IAC and decreased respiratory sounds is shared by the three RNDs. The latter could be highly relevant to define IBP in a spontaneously breathing patients. However, we believe that patients undergoing MV have their respiratory disturbance already partially solved by the ventilator.

Validation of the respiratory nursing diagnoses by experts

A comparison of the RND identified by the researcher and those identified by expert A and the researcher was made, as well as those identified by expert B, separately. Kappa

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>IGE</th>
<th>IAC</th>
<th>IGE and IAC</th>
<th>IAC and IBP</th>
<th>IGE, IAC and IBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal arterial blood gases</td>
<td>10 (100)</td>
<td>–</td>
<td>83 (94.3)</td>
<td>–</td>
<td>48 (84.2)</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>–</td>
<td>–</td>
<td>29 (33)</td>
<td>–</td>
<td>26 (45.6)</td>
</tr>
<tr>
<td>Hypercapnia</td>
<td>1 (10)</td>
<td>–</td>
<td>8 (9.1)</td>
<td>–</td>
<td>2 (3.5)</td>
</tr>
<tr>
<td>Restlessness*</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Hypoxemia</td>
<td>6 (60)</td>
<td>–</td>
<td>62 (70.5)</td>
<td>–</td>
<td>36 (63.2)</td>
</tr>
<tr>
<td>Dyspnea†</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>9 (15.8)</td>
</tr>
<tr>
<td>Rhythm/depth of breathing†</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2 (3.5)</td>
</tr>
<tr>
<td>Diaphoresis</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Decreased inspiratory pressure</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1 (100)</td>
<td>13 (22.8)</td>
</tr>
<tr>
<td>Decreased minute ventilation</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>Altered chest excursion</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Prolonged expiration phases</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3 (5.4)</td>
</tr>
<tr>
<td>Increased anterior-posterior diameter</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Cyanosis†</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>10 (17.5)</td>
</tr>
<tr>
<td>Abnormal breathing rate†</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>45 (78.9)</td>
</tr>
<tr>
<td>Decreased breath sounds</td>
<td>11 (52.4)</td>
<td>37 (42)</td>
<td>1 (100)</td>
<td>27 (47.4)</td>
<td></td>
</tr>
<tr>
<td>Rales</td>
<td>2 (9.5)</td>
<td>22 (25)</td>
<td>–</td>
<td>6 (10.5)</td>
<td></td>
</tr>
<tr>
<td>Rhonchi</td>
<td>13 (61.9)</td>
<td>50 (56.8)</td>
<td>34 (59.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheezes</td>
<td>3 (3.4)</td>
<td>–</td>
<td>1 (1.8)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are given as n (%).
* S&S shared by IGE and IAC according to Taxonomy II.
† S&S shared by IGE, IAC and IBP according to Taxonomy II.
analysis showed significant agreement between the experts and the researcher. The S&S that lead to disagreement are shown in Table 5.

The major disagreement was in relation to decreased breath sounds, followed by cyanosis. Tachycardia and Wheezes led to disagreement, although with less significance.

Tables 6–8 show the results of these analyses for each RND. IGE had $\kappa > 0.80 \ (p < 0.001)$ for both experts. The only disagreement regarding IGE definition was with the S&S tachycardia, because specialist B identified this RND when this S&S was the only cue. We believe that there were not

<table>
<thead>
<tr>
<th>RND</th>
<th>Signs and symptoms</th>
<th>Expert A</th>
<th>Expert B</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGE</td>
<td>Tachycardia</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>IAC</td>
<td>Decreased breath sounds</td>
<td>17*</td>
<td>7†</td>
</tr>
<tr>
<td></td>
<td>Wheezes</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>IBP</td>
<td>Cyanosis</td>
<td>5</td>
<td>–</td>
</tr>
</tbody>
</table>

*No definition of RND when the SS presented score 1 (light) and 2 (moderate).
†No definition of RND when the SS presented score 1 (light).

### Table 6 Agreement analysis of experts A and B with the researcher when identifying/impaired gas exchange

<table>
<thead>
<tr>
<th>Experts</th>
<th>Researcher – IGE</th>
<th>Kappa</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – IGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>23 (88.5)</td>
<td>3 (2.0)</td>
<td>26 (14.7)</td>
</tr>
<tr>
<td>Yes</td>
<td>3 (11.5)</td>
<td>148 (98.0)</td>
<td>151 (85.3)</td>
</tr>
<tr>
<td>Total</td>
<td>26 (100)</td>
<td>151 (100)</td>
<td>177 (100)</td>
</tr>
<tr>
<td>B – IGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>22 (84.6)</td>
<td>–</td>
<td>22 (12.4)</td>
</tr>
<tr>
<td>Yes</td>
<td>4 (15.4)</td>
<td>151 (100)</td>
<td>155 (86)</td>
</tr>
<tr>
<td>Total</td>
<td>26 (100)</td>
<td>151 (100)</td>
<td>177 (100)</td>
</tr>
</tbody>
</table>

Values are given as n (%).

### Table 7 Agreement analysis of experts A and B with the researcher when identifying/impaired breathing pattern

<table>
<thead>
<tr>
<th>Experts</th>
<th>Researcher – IBP</th>
<th>Kappa</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – IBP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>119 (100)</td>
<td>5 (8.6)</td>
<td>124 (70.1)</td>
</tr>
<tr>
<td>Yes</td>
<td>–</td>
<td>53 (91.4)</td>
<td>53 (29.9)</td>
</tr>
<tr>
<td>Total</td>
<td>119 (100)</td>
<td>58 (100)</td>
<td>177 (100)</td>
</tr>
<tr>
<td>B – IBP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>119 (100)</td>
<td>–</td>
<td>119 (67.2)</td>
</tr>
<tr>
<td>Yes</td>
<td>–</td>
<td>58 (100)</td>
<td>58 (32.8)</td>
</tr>
<tr>
<td>Total</td>
<td>119 (100)</td>
<td>58 (100)</td>
<td>177 (100)</td>
</tr>
</tbody>
</table>

Values are given as n (%).

### Table 8 Agreement analysis of experts A and B with the researcher when identifying/impaired airway clearance

<table>
<thead>
<tr>
<th>Experts</th>
<th>Researcher – IAC</th>
<th>Kappa</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – IAC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>8 (100)</td>
<td>20 (11.8)</td>
<td>28 (15.8)</td>
</tr>
<tr>
<td>Yes</td>
<td>–</td>
<td>149 (88.2)</td>
<td>149 (84.2)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (100)</td>
<td>169 (100)</td>
<td>177 (100)</td>
</tr>
<tr>
<td>B – IAC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>8 (100)</td>
<td>10 (5.9)</td>
<td>18 (10.2)</td>
</tr>
<tr>
<td>Yes</td>
<td>–</td>
<td>159 (94.1)</td>
<td>159 (89.8)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (100)</td>
<td>169 (100)</td>
<td>177 (100)</td>
</tr>
</tbody>
</table>
enough cues when physical examination was made to support the presence of IGE.

The major agreement was in relation to IBP (κ > 0·9 and κ = 1·0 for experts A and B, respectively) (p < 0·001). As shown in Table 5, cyanosis was the S&S that led to disagreement, but in few cases. IAC presented a mean agreement with κ = 0·4 and κ > 0·5 for experts A and B, respectively (p < 0·001). This mean agreement was in relation to decreased breath sounds; that is, when this S&S was the only cue, the presence of IAC was confirmed depending on the intensity degree score attributed to this S&S. Expert A identified IAC only if decreased breath sounds was given score 3 (intensified), and he refused this RND when it was given score 1 (light) or 2 (moderated). Expert B identified IAC if decreased breath sounds was given score 2 (moderated) or 3 (intensified), and refused it if the score was 1 (light).

Discussion

The relationship identified between IAC and intubation time can be explained by Meduri (1993), Amarante et al. (1997), who describe that, in critically ill patients under MV, the endotracheal tube can cause local inflammation with purulent drainage. Besides, sedatives and atropine use can increase mucous viscosity, which leads to difficult drainage mobilization. The association between IBP and intubation time suggests that some patients had difficulty being weaned off the ventilator.

The finding that PSV ventilation mode is a related factor for IBP is explained by the description of Huddleston (1990), Scanlan et al. (2000), that is, the PSV mode improves patient respiratory muscle function with the application of positive pressure only during inspiration. Therefore, the patient controls the inspiration time and volume. A maximum pressure is maintained by the machine provided there is the patient’s effort. Based on our clinical practice, we believe that, if a patient develops IBP, it will possibly be associated with an ineffective degree of sedation or an inappropriate ventilation mode for the patient’s clinical condition. This being the case, the presence of IBP can not be considered during critical care nurse evaluation if the patient is being ventilated with modes other than PSV.

Gordon and Hiltunen (1995) conducted a study to identify nursing diagnoses of high frequency and treatment priority in intensive care units. Of the 44 diagnoses identified as prevalent, IGE (92%) was always present, followed by IAC (87%) and IBP (81%). These findings coincide with our study, where IGE and IAC were associated with high frequency, that is, noticed in 88 (49·7%) evaluations. Taking NANDA’s Taxonomy II as a reference for S&S classification, the results shown in Table 2 lead to the description that follows.

Abnormal arterial blood gases were considered a critical S&S to define IGE as an isolated diagnosis, because it was identified in 100% of the evaluations. Hypercapnia was considered major, being identified in 60% of the evaluations. Hypercapnia was classified as minor, because it was considered an S&S that supports it, although sometimes it was not present to identify IGE. Rhonchi, with an occurrence of 61·9%, and decreased breath sounds, with an occurrence of 52·4%, were considered major S&S to define IAC as an isolated diagnosis.

As to the shared S&S, according to Taxonomy II, in the three RNDs there was always zero occurrence when the RND was identified as isolated, which means that they were poorly precise to develop each one of the thre RNDs. A slightly higher occurrence of these S&S was noticed when the three RNDs were identified as associated. However, the only S&S with a more significant frequency was abnormal breathing rate identified in 45 (78·9%) evaluations.

When the S&S of the three RNDs were clustered, we noticed a superposition of IGE S&S (abnormal arterial blood gases and hypoxemia) with IAC S&S (rhonchi and decreased breath sounds). However, these results were expected, since IGE and IAC were the identified diagnoses associated with higher frequency in 145 (81·9%) evaluations.

Based on our clinical experience, it is expected that in critically ill patients undergoing MV, IAC and IGE can be associated in several cases, not only because of the acute pathology, but also because of the complications related to intubation and prolonged MV (more than 48 hours). This is confirmed by the American Thoracic Society (1995) and Kolleff et al. (1999) who explain that intubation and MV inhibit the mucociliary activity, eliminate the cough reflex and facilitate the aspiration of oropharynx contaminated secretions.

Despite Huddleston’s (1990) description of the therapeutic use of MV, PEEP and high levels of FiO₂ being able to improve pulmonary ventilation, they are extremely hazardous to pulmonary parenchyma, leading to inflammatory/immune responses and an exacerbation of the imbalance of the ventilation (V) and perfusion (Q) relationship. In addition, for an adequate gas exchange to be achieved, the alveolar ventilation must be identical to the alveolar perfusion. However, regional differences at V/Q ratio can occur even in a normal lung. As to IGE, the causes can be traced back to problems with V (atelectasis, pneumonia, acute respiratory distress syndrome, pulmonary edema), or with Q (embolism, acute respiratory distress syndrome).
Titer and Alpen (1999) explain that PaCO$_2$ elevation result from an inability to eliminate CO$_2$ across the respiratory system, secondary to airway obstruction resulting in hypercapnia. On the other hand, several circumstances can lead to a low PaO$_2$, including O$_2$ decreased inspiration, secondary to airway obstruction, leading to hypoxemia.

Carvalho (2000) described that in patients under MV, the main causes for airway obstruction are the canula’s anomalous position; selective intubation; presence of drainage or blood, stenosis.

Therefore, in a patient undergoing MV, airway obstruction can be related to V/Q mismatch, because the obstruction can, in turn, lead to areas of atelectasis, which are prone to bacterial colonization. Thus, some IAC S&S can be predictive of IGE and vice versa. More experienced nurses may manage this crossing more precisely.

It is important to highlight the methodological and sample differences between the revised studies, with similar design, and the actual research. These differences perhaps make it difficult to compare our results with other studies’s results, but they are what we have at the moment.

Carlson-Catalano et al. (1998) carried out a clinical validation study of IGE, IAC and IBP S&S through Ferhing’s (1987) Clinical Diagnostic Validity Model. The S&S seen as critical to diagnoses development were dyspnea and fatigue expression for IBP; difficult expectoration; abnormal breathing sounds, pulmonary congestion, sputum, cough and anxiety for IAC; and for IGE, the critical S&S were abnormal arterial blood gases and fatigue expression.

Martins (1996) carried out a validation study of IAC based on Ferhing’s (1987) Clinical Diagnostic Validation Model. The S&S identified with higher frequency were abnormal breathing rate (75%), abnormal breathing depth and rhonchi (63%, respectively), dyspnea (60%) and rales (53.7%).

Brukowitzki et al. (1996) carried out a validation study of IAC based on Ferhing’s (1987) Diagnostic Content Validation. Out of the 29 S&S, only ineffective cough was considered a critical one. Rhonchi, rales, abnormal breathing rate, tachypnoea, cyanoses and dyspnoea were all considered minor S&S.

McDonald (1985) carried out a validation study to find out the frequency of S&S in three RNDs in a general ICU. The S&S identified with higher frequency were ineffective cough (84%), decreased breath sounds (79%), pain (53%), dyspnea (47%), shallow respiration and abnormal blood gases (42%).

The studies above have not been developed exclusively with patients undergoing MV, so their results coincide partially with our findings. According to our findings we have concluded that abnormal arterial blood gases and hypoxemia are the critical S&S to identify IGE in patients undergoing MV. Rhonchi and decreased breath sounds are critical S&S in an IAC diagnosis, and these coincide with Taxonomy II.

On the other hand, the existing interface between IAC and IGE is confirmed by the presence of the shared critical S&S, that is, rhonchi, decreased breath sounds, abnormal blood gases and hypoxemia, which do not coincide with NANDA’s proposition. The noticed low frequency of the shared S&S proposed by NANDA in this study pointed to the fact that they are less accurate to define the RNDs, even when they were identified in association. Therefore, if a nurse identifies IGE in a patient undergoing MV, we suggest two things. Firstly, to consider the possibility of risk for IAC, (and vice versa) even when no S&S for the latter has been identified. Secondly, that the critical S&S shared by IAC and IGE be incorporated into Taxonomy II, although other studies with patients under MV are necessary to confirm this proposition.

In a consensus presented by the American Association of Critical Care Nurses (1990), IGE and IAC were classified as highly frequent and a high priority for treatment. IBP was classified as low frequency and high priority for treatment. In our study, IBP was identified with low frequency and always as a result of inappropriate adjustment of ventilator’s parameters, which was quickly solved by the health staff. We suggest nurses should be careful in their clinical evaluation if only the S&S shared by the RND are identified, because the patient may be presenting another RND, but not IBP. As for the validation of the RND by experts, the high agreement assigned to IGE was due to the great occurrence of abnormal blood gases and hypoxemia, both critical S&S to define this RND.

Abnormal blood gases were present at the moment of data collection, and also when PaO$_2$/FiO$_2$ ratio was low, despite normal arterial gasometry. The experts have adopted the same evaluation criterion and there was agreement in almost all cases. Therefore, we suggest that, regarding patients undergoing MV, the nurse must estimate PaO$_2$/FiO$_2$ ratio, because the arterial gasometry can be normal, but at the cost of a high FiO$_2$ (> 50%) at the mechanical ventilator.

As to cyanoses, although congruent with IBP, it is shared by the three RNDs, according to Taxonomy II and other causes can be identified like decreased cardiac output or diminished tissue perfusion, for example. Therefore, it can be considered a minor S&S for IBP. We agree with specialist A (Table 3) because, to identify IBP the presence of other cues, is necessary to guarantee an accurate diagnosis.

Notice that scores with intensity degree (0–3) could be seen in nursing clinical practice as indicators of the patient’s improvement, worsening or the outcomes of nursing intervention. For example, decreased breath sounds, rhonchi and
other, with a score of 3 could point to an alarm situation. If the score decreases, it could indicate that the nursing interventions were good, with satisfactory outcomes.

The medium agreement attributed to IAC was due to the S&S diminished breath sounds. During data collection, we believed that the presence of this S&S was strongly associated with areas of atelectasis due to the underlying pathology, thorax X-ray with cupule’s elevation, selective intubation, long time intubation with difficult weaning. However, in some evaluations we have probably mistaken some IAC diagnosis.

Several factors can lead to atelectasis in a patient undergoing MV. For example, long stay in bed, supine position, mucociliary activity inhibition caused by anesthesia and sedation and decreased inspiratory volumes (Huddleston 1990). It is expected that patients undergoing MV are receiving satisfactory air volumes. However, therapeutic manoeuvres such as disconnecting the MV for endotracheal suction can precipitate atelectasis, especially when the ventilatory mode is associated with a high PEEP.

Therefore, after expert validation, we suggest that when the only cue is decreased breath sounds, critical care nurses must look for other cues to confirm the presence of IAC, unless they confirm the presence of atelectasis associated with sputum or mucus in a small airway. Wheezes were not a critical S&S to define IAC in this study. When this S&S is the only cue, critical care nurses should consider the possibility of risk for IAC, once, as described by Skeleton and Nield (1987), wheezes can reflect the presence of mucus in a small airway.

Conclusion

When the RNDs were identified in isolation, the critical S&S for IGE were abnormal blood gases and hypoxemia. For IAC, they were rhonchi and decreased breath sounds and, for this latter S&S, it is recommended to look for other cues to confirm IAC. No highlights were found for IBP signs and symptoms. Validation by experts has confirmed these findings. The interface between IAC and IGE was confirmed by the presence of the shared critical S&S, which could be incorporated to NANDA’s Taxonomy II. However, other validation studies with patients undergoing MV are necessary to confirm this proposition. The relation found between IGE and IAC, confirmed by two experts, that is, in 88 (49-7%) evaluations can be indicative of the presence of a Respiratory Syndrome. We also suggest the incorporation of intubation time to Nanda’s Taxonomy II as a related factor for IAC and IBP and the PSV ventilation modality as a related factor for IBP. Studies like this are relevant to clinical practice, because they verify the adequacy of Taxonomy II for patients under MV directly in clinical practice, thus allowing for intensive care nurses to go from a mechanical and routine practice to a critical and reflexive practice committed to professional progress.

Contributions

Study design: SSZ, ALBLB, JLMM, ARCB; data collection and analysis: SSZ, ALBLB, JLMM, ARCB; manuscript preparation: SSZ, ALBLB, JLMM, ARCB

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