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Original Article

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Comparison between the Comfort and Hartwig sedation scales in pediatric patients undergoing mechanical lung ventilation

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ABSTRACT

Context: A high number of hospitalized children do not receive adequate sedation due to inadequate evaluation and use of such agents. With the increase in knowledge of sedation and analgesia in recent years, concern has also risen, such that it is now not acceptable that incorrect evaluations of the state of children's pain and anxiety are made.
Objective: A comparison between the Comfort and Hartwig sedation scales in pediatric patients undergoing mechanical lung ventilation.
Design: Prospective cohort study.
Setting: A pediatric intensive care unit with three beds at an urban teaching hospital.
Patients: Thirty simultaneous and independent observations were conducted by specialists on 18 patients studied.
Diagnostic Test: Comfort and Hartwig scales were applied, after 3 minutes of observation.
Main Measurements: Agreement rate (kappa).
Results: On the Comfort scale, the averages for adequately sedated, insufficiently sedated, and over-sedated were 20.28 (SD 2.78), 27.5 (SD 0.70), and 15.1 (SD 1.10), respectively, whereas on the Hartwig scale, the averages for adequately sedated, insufficiently sedated, and over-sedated were 16.35 (SD 0.77), 20.85 (SD 1.57), and 13.0 (SD 0.89), respectively. The observed agreement rate was 63% ($p = 0.006$) and the expected agreement rate was 44% with a Kappa coefficient of 0.345238 ($z = 2.49$).
Conclusions: In our study there was no statistically significant difference whether the more complex Comfort scale was applied (8 physiological and behavioral parameters) or the less complex Hartwig scale (5 behavioral parameters) was applied to assess the sedation of mechanically ventilated pediatric patients.
Key-words: Sedation scale. Comfort. Hartwig. Mechanical Lung Ventilation. Pediatric Intensive Care.

INTRODUCTION

One of the most important goals in the treatment within pediatric intensive care units (PICUs) is the management of pain and distress in children receiving artificial ventilation. Controlled studies have demonstrated reduced morbidity and mortality rates in patients when adequate analgesia is provided.[1, 2] To maintain low levels of stress, pain and fear, these patients require special attention from nursing staff and parents, but additional pharmacological treatment is also necessary. Therefore PICU staff routinely attempt to control distress by administering sedatives and analgesics, and/or managing the social and physical environment. However, to determine the effect of sedation, many sedation-score scales have been developed in order to reduce the subjective impressions, which lead to wide individual variation in evaluation among the clinical staff.

The Comfort scale[3] is based around eight behavioral and physiological parameters developed from literature reviews and surveys among experienced PICU nurses. This empirical scale is a reliable and valid method for assessing children's distress and it is non-intrusive, multidimensional, suitable for

continuous observation, and it may include variables that remain variable in the face of the continuously changing state of the patient's disease.

The Hartwig scale[4] is a less complex sedation score based on five behavioral criteria. This is another empirical scale developed from surveys among experienced PICU nurses. It was devised to quantify the effect of sedation during routine procedures such as tracheal aspiration and its validity and reliability in the clinical assessment of the degree of sedation in patient populations has already been demonstrated.

We performed a prospective trial comparing these two sedation scales in pediatric patients undergoing mechanical ventilation.

METHODS

Study population. The study was conducted during an 11-month period from March 1995 to January 1996 in the PICU at Hospital do Servidor Público Municipal (HSPM) in São Paulo, Brazil. To evaluate agreement between these two sedation scales we performed simultaneous and independent ratings conducted by specialist pediatric intensive care physicians using the American Comfort scale (Fig 1) and the European Hartwig scale (Fig 2) in pediatric patients undergoing mechanical ventilation.

Inclusion criteria. a) age < 18 years; b) mechanically ventilated patients receiving intermittent mandatory ventilation or continuous positive airway pressure; c) patients with endotracheal intubation or with a tracheostomy in place. Each patient was sedated by the managing physician using opiates, benzodiazepines, barbiturates, or a combination of these medications. All patients had continuous cardiorespiratory monitoring, and blood pressure monitoring via an inserted arterial catheter.

Exclusion criteria. a) head injury; b) ischemic encephalopathy; c) stroke; d) mental dysfunction; e) multiple trauma within 72 hours of the study; f) abnormalities of muscle function;

	1	2	3	4	5
A. motor response	No spontaneous movements	Spontaneous movements with pain	Spontaneous movements of extremities	Spontaneous global movements	Continuous spontaneous movements, restless
B. mimic	No reaction	Grimacing only with pain	Crying only when with pain, rapid returns to rest	Crying even without pain, but soon returns to rest	Crying difficult to soothe
C. eyes	Permanently closed	Opening only with pain	Opening when manipulated, quickly falls asleep again	Spontaneous opening, soon returns to sleep	Spontaneous opening, awake for long periods, sweating
D. respiration			Easy, spontaneous breathing, fully synchronized	Mechanical respiration not disturbed by spontaneous breathing	Spontaneous breathing not synchronous to the machine, tachypnea
E. aspiration		No reaction when aspirated	Grimacing only, no movements of extremities	Little coughing or retching	Strong opposition, intense coughing, straining

Figure 2. The Hartwig scale[4] - One point was given for the highest and 5 points for the lowest rate of sedation (ranging from 8 to 25 points). We considered sedation as excessive in the range 8 to 14, adequate (15 to 18) or insufficient (19 to 25).

	1	2	3	4	5
A. Alertness	Deeply asleep	Lightly asleep	Drowsy	Fully awake and alert	Hyper-alert
B. Calmness agitation	Calm	Slightly anxious	Anxious	Very anxious	Panicky
C. Respiratory response	No coughing and no spontaneous respiration	Spontaneous respiration with little or no response to ventilation	Occasional cough or resistance to ventilator	Actively breathing against ventilator or cough regular	Fighting against ventilator; coughing or choking
D. Physical movement	No movement	Occasional, slight movements	Frequent, slight movements	Vigorous movements limited to extremities	Vigorous movements including torso and head
E. Blood pressure (MAP) baseline	Blood pressure below baseline	Blood pressure consistently at baseline	Infrequent elevations of 15% or more (1 - 3)	Frequent elevations of 15% or more (more than 3)	Sustained elevation of ≥ 15%
F. Heart rate baseline	Heart rate below baseline	Heart rate consistently at baseline	Infrequent elevations of 15% or more above baseline (1-3) during observation period	Frequent elevations of 15% or more above baseline (more than 3)	Sustained elevation of ≥ 15%
G. Muscle tone	Muscles completely relaxed; no muscle tone	Reduced muscle tone	Normal muscle tone	Increased muscle tone and flexion of fingers and toes	Extreme muscle rigidity and flexion of fingers and toes
H. Facial tension	Facial muscles completely relaxed	Facial muscles tone normal; no facial muscle tension evident	Evident tension in some facial muscles	Evident tension throughout facial muscles	Facial muscles contorted and grimacing

Figure 1 - The COMFORT scale[3] - One point was given for the highest and 5 points for the lowest rate of sedation (range from 8 to 40 points). We considered sedation as excessive in the range 8 to 16, adequate (17 to 26) or insufficient (27 to 40).

g) neuromuscular blockage; h) chronic cough. The exclusion criteria were selected to ensure that normal neurologic responses were being assessed, thus avoiding misunderstanding of items assessed by these two sedation scales (such as muscle tone or response to the ventilator), and to reduce the likelihood of distress due to uncontrolled pain.

Data collection and definitions. Each study consisted of a 3-minute period of intensive observation of the patient in his or her pediatric ICU bed. After each observation, evaluations using Comfort scoring (ranging from 8 to 40) and Hartwig scoring (ranging from 8 to 25) were done by the specialist. We graded the sedation given by Comfort scores as follows: adequate (17 to 26 points), excessive (8 to 16 points) and insufficient (27 to 40 points). Using the Hartwig scores, the corresponding sedation grades were: adequate (15 to 18 points), excessive (8 to 14 points) and insufficient (19 to 25 points).

Statistical methods. We used the agreement rate (kappa) with unitized distribution, and $p < 0.01$ was considered significant.[5]

RESULTS

This study comprised 30 observations in 18 mechanically ventilated pediatric patients aged 16 days to 5 years (mean: 16.45 months, SD 17.27; see Table 1) and the reason for PICU admission were: cardiac disease - 1 case (5.5%); neurologic disease - 1 case (5.5%); infectious disease - 7 cases (39%); respiratory disease - 9 cases (50%).

Table 1 - Age of PICU patient at the time of observation

Infants (newborn to 12 months)	1 (5.5%)
Toddler (from 13 to 23 months)	12 (66.7%)
Preschool (from 24 to71 months)	5 (27.8%)

The analysis of the degree of sedation in our patients obtained by applying the Comfort and Hartwig scales showed almost the same results among those with adequate sedation (Table 2).

On the Comfort scale, the mean scores for adequate, insufficient and excessive sedation were: 20.28 (SD 2.78), 27.5 (SD 0.70), and 15.1 (SD 1.10), respectively. On the Hartwig scale, the average scores for adequate, insufficient and excessive sedation were: 16.35 (SD 0.77), 20.85 (SD 1.57), and 13 (SD 0.89), respectively. The analysis of agreement between Comfort and Hartwig scores is presented in the table 2.

DISCUSSION

In recent years the administration of sedative and analgesic agents has been widely studied and such agents have been applied in the control of stress in critically ill patients, especially children. Sedation and analgesia are known to be powerful instruments providing comfort and reducing complications.[6] The utilization of these drugs has been frequently based on subjective personal evaluation without a valid objective method of measuring the distress.

Although a number of reliable and valid

Table 2 - Quality of sedatinon and analysis of agreement between Comfort and Hartwig scores

	Comfort grade			
Hartwig grade	Over-sedated	Adequately sedated	Insufficiently sedated	**Total**
Over-sedated	5	3	0	**8 (26.6%)**
Adequately sedated	5	12	0	**17 (56.7%)**
Insufficiently sedated	0	3	2	**5 (16.7%)**
total	**10 (33.4%)**	**18 (60.9%)**	**2 (6.6%)**	**30 (100%)**

Observed agreement rate: 63%; p = 0.006; Expected agreement rate: 44%; Kappa coefficient: 0.345238 z= 2

methods have been developed to provide observers with a rating of behavioral and physiological indices for children's distress during hospitalization in PICUs, these scales have specific characteristics that may be questioned. Some scales have been developed from the observation of reactions during painful procedures.[7] These scales appear inadequate for continuous observation because of the stress factor during the nociceptive stimulation procedure. In addition, other objective scales are inapplicable in pediatric intensive care units because they do not evaluate neonatal or critically ill patients.[8]

In order to get more experience in the application of objective sedation scales and to try to validate a less complex scale with fewer variables, we made a comparison between two distinct methods.

The Comfort scale has previously been shown to be reliable and has been validated as a descriptor of behavioral and physiological distress with good results. However, its application is not easy because of the great number of variables (eight), thus rendering it not very practical. In addition to this, its applicability is questionable when used in a routine manner.

The Hartwig scale measures only behavioral variables, and therefore has an advantage because of its facility of application. The need for endotracheal aspiration is questionable due to the painfulness of this procedure, thus affecting the goal of our study on sedation. Nevertheless, this fact is minimized as it is a routine procedure done in artificially ventilated patients. Both scales were designed to be age-independent and used at any time to assess the adequacy of sedation at that point in time. For this reason repeated observations of the same patient were not excluded.

We noted that there was a low standard desviation for the means considered for the degrees of sedation on both sedation scales. When the results were analyzed, the agreement rate observed was 63%, and it was statistically significant because there was little difference between the scores in spite of the fact that we had a low *n* in our sample.

CONCLUSION

There was no statistical difference when the Comfort and Hartwig scales were applied in mechanically ventilated children, therefore allowing their use in daily clinical practice.

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RESUMO

Contexto: É elevado o número de crianças hospitalizadas que não recebem uma sedação adequada, devido a avaliação e ao uso inadequado desses agentes. Nos últimos anos aumentou a preocupação e os conhecimentos a respeito da sedação e analgesia, de tal modo que é inaceitável hoje em dia termos uma criança sem correta avaliação de seu estado de dor e ansiedade. **Objetivo:** Comparar o uso de duas escalas de sedação (COMFORT e HARTWIG) em pacientes pediátricos em ventilação pulmonar mecânica. **Tipo de estudo:** Estudo prospectivo. **Local:** Unidade de cuidados intensivos pediátricos de hospital terciário. **Participantes:** Realizadas 30 observações, simultâneas e independentes, em 18 pacientes, por médicos especializados. **Teste diagnóstico:** Após observação de três minutos, aplicou-se critérios objetivos (escalas de COMFORT e HARTWIG) para avaliar a sedação. **Variável estudada:** Taxa de concordância (Coeficiente Kappa) onde $p < 0,01$ foi considerado significante. **Resultados:** Escala COMFORT (média e desvio padrão) para adequadamente sedado, inadequadamente sedado e muito sedado foi 20,28 ± 2,78, 27,5 ± 0,70 e 15,1 ± 1,10 respectivamente. Para a escala de HARTWIG: 16,35 ± 0,77, 20,85 ± 1,57 e 13,0 ± 0,89. Taxa de concordância observada 63% ($p = 0,006$), esperada de 44% com o coeficiente kappa = 0,345238 ($z = 2,49$). **Conclusões**: Em nosso estudo, não houve diferença significativa na aplicabilidade entre as escalas de COMFORT e HARTWIG em assegurar o nível de sedação em crianças submetidas a ventilação pulmonar mecânica.

Palavras-chave: Escala de sedação. Confort. Hartwig. Ventilação pulmonar mecânica. Cuidados intensivos pediátricos.