The Effect of a Sedation Scale on Ventilation Hours, Sedative, Analgesic and Inotropic use in an Intensive Care Unit

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ABSTRACT

Objective: *Sedative drugs are used routinely in critically ill patients to reduce both physical and psychological stresses imposed by the hostile intensive care unit environment. However, drug accumulation, particularly during prolonged administration, often poses difficulties. Sedation scales chart the physiological effect of sedation although many surveys have revealed that few units use them to monitor the effect of sedative agents hence oversedation is common.*

Methods: *We evaluated the impact of a modified Sheffield sedation scale on ventilation hours, sedative, analgesic and inotropic use in an intensive care unit. After an education course on the use of the sedation scale, it was utilised from June 2000 to February 2001. After this 9 month period, the pharmacy and health information services retrieved data on ventilation hours and sedative, analgesic and inotropic use from June 2000 to February 2001 and compared it with data retrieved from a similar period prior to sedation scale use from June 1999 to February 2000.*

Results: *The population studied during both periods were similar in terms of total ventilated patients (141 versus 147), mean age (59.6 versus 61.2) major casemix groupings, discharge destination and hospital mortality (31% versus 31%). After introducing the sedation scale the average patient ventilated hours decreased from 203.7 to 179.5 hours. The intensive care unit's use of midazolam decreased by 38.38%, morphine use decreased by 52.6% and propofol use decreased by 17.3%. Also the adrenaline use decreased by 13.95%, noradrenaline use decreased by 8.25% and dopamine use decreased by 35.7%.*

Conclusions: *Our study demonstrates that the use of a sedation scale lead to a decrease in sedative, analgesic and inotrope use with a trend to less ventilated hours in critically ill patients.* (**Critical Care and Resuscitation 2004; 6: 253-257**)

Key words: Sedation scale, sedation, analgesia, inotrope, intensive care

Sedation of the critically ill patient is required to reduce both the physical and psychological stress associated with a hostile environment that includes invasive procedures, mechanical ventilation, disorientation, fear, depression, pain and sleep disturbances. However, sedative drug use in the intensive care unit poses difficulties arising from length of administration and potential drug accumulation. The commonly administered sedatives are benzodiazepines[1] and propofol.[2] A recent e-mail survey of European intensive care units revealed a significant variation in sedative and analgesic practice[3] with midazolam and propofol being the most commonly used sedative agents and morphine, fentanyl and sufentanil as the most frequently used analgesic agents. The European survey noted that the use of a sedation scale varied from 72% in the United Kingdom to 18% in Austria. A mail survey of Australian intensive care units revealed that morphine and midazolam were the most widely used drugs and that excess sedation was common, occurring in 32% of cases.[4] Only 17% of Australian intensive care units used sedation scales.

In many intensive care units sedatives are infused continuously.[1] A recent study revealed that in patients undergoing mechanical ventilation, daily interruption of sedative drug infusions decreases the duration of

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mechanical ventilation and length of stay in the intensive care unit.[5] Given that sedative and analgesic agents have altered pharmacodynamics and pharmacokinetics in the critically ill, we considered a sedation scale as the most appropriate way to determine a patients sedation requirements. We undertook a study to determine whether a sedation scale was easy to institute and if its introduction would have an effect on ventilation hours and sedative, analgesic and inotropic use in our intensive care unit.

METHODS

A multidisciplinary workshop was held and a review of literature on sedation was sourced from Pubmed and Medline. Sedation scales were reviewed and a modified Sheffield sedation scale was employed (table 1).[6] The modified Sheffield sedation scale was selected as a tool that, by the nature of the specific descriptors, allowed assessment of an actual state of sedation and prescription of a specific end point of sedative usage. One of the original descriptors was deleted to minimise confusion between two levels of optimal sedation.

After staff education, the sedation scale was utilised from June 2000 for all mechanically ventilated patients. During the twice daily consultant ward rounds, a level of sedation was chosen and sedative and analgesic drugs were titrated and, in some cases, discontinued to achieve the required level of sedation. The drugs most commonly used were morphine and midazolam as infusions. Propofol was favoured when a short period of ventilation was envisaged and extubation was imminent. After a nine month period using the sedation scale, the pharmacy and health information services retrieved data on ventilation hours, sedative, analgesic and inotrope use in all patients admitted to the intensive care unit. Similar data were obtained from an identical period prior to the introduction of the sedation scale from June 1999 to February 2000. Neither the pharmacy nor the health information services were aware of the sedation scales introduction during data collection. Baseline demographic data, simplified acute physiology II (SAP II) score and the reason for admission to the intensive care unit were retrospectively recorded in both patient groups (table 2).

Table 1. Modified Sheffield sedation scale

1. *AWAKE*
   Patients should be awake and orientated requiring minimal or no sedation. They should be self-ventilating, either through a face mask or through an endotracheal tube, with minimal discomfort. This level should be reached by a patient prior to being extubated after having gone through the weaning process successfully. This level is what is aimed for in many patients who are ventilated.

2. *AGITATION*
   The patient is showing signs of agitation and restlessness, compromising ventilation, oxygenation and their general condition. Observe for signs of distress during physiotherapy, endotracheal tube and oropharyngeal suctioning and with general handling.

3. *OPTIMAL*
   The patient is just asleep but should respond to speech and touch, either by squeezing the nurses hand, or by blinking. The patient will allow treatment and general nursing care, physiotherapy and suction without compromising ventilation or cardiovascular state. The patient may require a bolus of sedation as well as background sedation to cover handling during care, physiotherapy and invasive procedures.

4. *SLUGGISH*
   The patient has a dull or sluggish response to any stimulation (i.e glabellar tap or with endotracheal tube suctioning).

5. *FLAT*
   The patient is showing no response to stimulation of any kind.

Levels 1 and 3 were considered desirable. Level 2 was considered unacceptable. Levels 4 and 5 were only acceptable in certain circumstances - a) Neuromuscular blockers and heavy sedation was required to achieve patient comfort, or b) An extremely ill and unstable patient where heavy sedation was required to manage the critical condition. The scale was recorded 4-hourly in all patients. An hourly score was required if sedatives were altered until the desired level was achieved. Sedation was not to be increased to achieve a deeper level of sedation without first consulting with the nurse in charge.

Table 2. Characteristics of the study patients

	Pre sedation scale	*Post sedation scale*
Study period	June 1999 - February 2000	June 2000 - February 2001
Total ventilated patients	141	147
Mean age (years)	59.6	61.2
Mean SAP II score*	41	45
Average ventilated hours	203.7	179.5
Gender	81 Male (57%)	Male 88 (59%)
	60 Female (42%)	Female 59 (40%)
Discharge destination	Transferred to ward 44 (31.20%)	Transferred to ward 49 (33%)
	Died 44 (31%)	Died 46 (31%)
	Discharged home 49 (34.75%)	Discharged home 47 (32%)
	Other 4 (2.83%)	Other 5 (3%)
Epidural catheter	29 (20.5%)	27 (18.36%)
Major casemix groupings	Tracheostomy and/or > 96 hours of CMV (64 patients)	Tracheostomy and/or > 96 hours of CMV (60 patients)
	Poisoning 11 patients	Poisoning 14 patients
	Major bowel procedures 8 patients	Major bowel procedures 8 patients
	Circulatory disorders 8 patients	Circulatory disorders 6 patients
	Respiratory disorders 7 patients	Respiratory disorders 5 patients
	Major vascular surgery 8 patients	Major vascular surgery 8 patients

SAP II score = simplified acute physiological score, CMV = continuous mechanical ventilation.

Statistical analysis

The SPSS statistical package was used to analyse the data. Descriptive data are given as mean values. Statistical comparison of ventilated hours were undertaken using Students *t test* of the log-transformed data since the data were positively skewed. Statistical significance was accepted at the $p<.05$ level.

RESULTS

After introduction of the sedation scale, 147 patients were ventilated from June 2000 to February 2000. Prior to the introduction of the sedation scale a total of 141 patients were ventilated from June 1999 to February 2000. The demographic characteristics, SAP II scores and major casemix groupings were similar in the two study periods (Table 2).

The average number of ventilated hours for the 141 'pre-sedation scale' patients was 203.7 hours. The average number of ventilated hours for the post-sedation scale patients was 179.5 hours. This result did not achieve statistical significance due to the widespread variation in ventilation hours (p = 117). The mean age, discharge destination and major casemix groupings were similar for the two periods. The mean age was 59.62 years for the pre sedation scale patients and 61.25 years for the post sedation scale patients. The epidural analgesia usage for both pre- and post-sedation scale patients were similar with 29 patients in the former group and 27 patients in the latter group (table 2). The mortality for both pre- and post-sedation scale patients was 31%.

The total dose of sedative and analgesic agents decreased considerably after the initiation of the sedation scale. For example, the total midazolam use for the 9 month period decreased from 172 g to 105 g (38.38% reduction), the total morphine use decreased from 205.4 g to 97.35 g (52.6% reduction) and the total propofol use decreased from 802.5 g to 663 g (17.3% reduction). The total inotropic use also decreased for the 9 month period. For example, the total adrenaline use decreased from 6.59 g to 5.713 g (13.95% reduction) the total noradrenaline use decreased from 2.688 g to 2.466 g (8.25% reduction) and the total dopamine use decreased from 47.8 g to 30.7 g (35.7% reduction).

DISCUSSION

With the advances in mechanical ventilation and the pharmacodynamics and pharmacokinetics of sedative and analgesic agents used in the intensive care unit, the practice of managing the critically ill mechanically ventilated patient has changed over the past two decades. Clinicians are now required to consider not only what mechanical ventilation settings to use but also what sedative to use, how much should be administered, how should it be administered and what clinical endpoints should be evaluated. The wide variation in the type of sedatives prescribed in the
United Kingdom and Europe suggest no uniformity in prescribing.[3] Data from the United States in 1997 revealed approximately $ 80.78 billion was spent on

intensive care therapy,[7] with about 10% of this spent on drugs.[8] Any measures that lead to improvement in patient care as well as cost savings would have a significant benefit for the management of the critically ill patient. We hypothesised that given the significant alterations in pharmacokinetics and pharmacodynamics that occur in the critically ill patient, a sedation scale, measuring clinical endpoints, would probably be useful when tailoring sedation to the particular needs of the patient.

In our study, the introduction of a sedation scale lead to a reduction in the duration of mechanical ventilation from 203.7 to 179.5 hours ($p = 0.117$). While this result was not statistically significant, there was a trend to less time ventilated. The use of the modified Sheffield sedation scale lead to a significant reduction in sedative and analgesic use with the pharmacy recording a 17.38% reduction in propofol use, a 38.38% reduction in midazolam use and a 52.61 % reduction in morphine use. There was also a reduction in total inotrope use. After the introduction of the sedation scale the noradrenaline use decreased by 8.25%, adrenaline use decreased by 13.95% and dopamine use decreased by 35.77%. The mean SAP II score pre-sedation scale was 41, compared with the post sedation SAP II score scale of 45 suggesting that the decreased inotrope requirements was not due to a less critically ill group of patients in the post intervention period. While excessive sedative and analgesic use has been associated with enteral feed intolerance,[9] data were not collected on this aspect in our study.

This study has a number of limitations. The data obtained by the health information services on demographics, SAP II scores and ventilation hours were obtained from a retrospective chart review. Pharmacy data on total sedative, analgesic and inotrope use were retrieved by the pharmacy services during both periods. Neither the pharmacy nor health information services were aware of any intervention in the intensive care unit, and data requested were collected routinely by the relevant departments. We were not aware of any increase in discomfort or distress in the group of patients who received less sedation and analgesia and believe that this was unlikely as patients were constantly evaluated and the appropriate level of sedation according to the sedation scale was achieved.

These data are consistent with recent data suggesting that a continuous infusion, compared with an intermittent infusion, of sedative agents, prolongs mechanical ventilation.[10] Our study suggests that if a clinical endpoint for sedation is established, sedative and analgesic use will decrease which was also associated with a decrease in inotrope requirements. The implications of these observations are that strategies that are associated with less sedative and analgesic use may have significant implications for the critically ill patient. For example, the arrythmogenic and myocardial ischaemic effects of inotropes may be reduced with the use of lower concentrations of these agents in less sedated patients. Recent data suggests that intensive insulin therapy reduces morbidity and mortality in the intensive care patient.[11] In this regard, catecholamine induced hyperglycaemia could lead to an increase in morbidity and mortality.

In conclusion, strategies to decrease sedative and analgesic use in the intensive care unit may have a cascade of beneficial effects on the use of many other drugs that are routinely used in the intensive care unit. This may have significant therapeutic as well as cost benefits, by decreasing ventilation hours and may even decrease mortality and morbidity.

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