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Changing Analgosedation Practice in Critical Care: A Nurse-Driven Monitoring Protocol

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Abstract

Objective: To improve the systematic monitoring of pain and sedation levels following the implementation of a nurse-guided ASP. To determine its influence on medication management and clinical outcomes in critical patient on mechanical ventilation.

Method: Cohort study, from March 2013 to May 2015. Patients with mechanical ventilation ≥ 24 hours and perfusion sedation were included. Variables: demographic characteristics, pain and sedation assessment records, daily dose and frequency of analgosedation use, ventilation times, incidence of ventilator-associated pneumonia (VAP), reintubation, length of stay and mortality in hospital and ICU. Descriptive statistics, Student's t or U-Mann-Whitney, Chi square or Fisher's test, significance p≤0.05.

Results: There were a total amount of 242 patients analyzed, (105 in control group and 137 in protocol group) of 55.1(±15) years old. Women 41%. Registers of pain and sedation/agitation, median (interquartile range): communicative patients [0(0-1) vs 2(0-4): p <0.0001], non-communicative [0(0-3) vs 3(1-6); p <0.0001]; sedated patients [3(0-13.7) vs 19(8-31.5): p <0.0001].

Sedative dose, median (interquartile range): midazolam [318(231.2-452.6) vs 223(152.8-549.2) mg/day; p=0.001)], propofol [1930(1045-2589) vs 1650(845.8-2090) mg/day; p=0.04)]. Frequency of use: dexmedetomidine (2.8 vs. 15.9%; p=0.001), paracetamol (64.8 vs. 82.6%; p=0.001), metamizole (24.6 vs. 31.4%;p=0.04), morphine (75.9 vs. 61.6%;p=0.017).

Ventilation time, median (interquartile range): 4.7(1.9-10.3) vs 4(1.7-8.6) days; p=0.33. Incidence of VAP (25 vs 14%; p=0.02), reintubation (15 vs 9%; p=0.45). Stay, median (interquartile range): ICU [11(7-19) vs 11(7-18) days; p=0.73]; hospital [30.51(18-55) vs 25(16-41) days; p=0.21)]. ICU mortality (13 vs. 4.3%; p=0.01), hospital (16 vs. 10%; p=0.14).

Conclusions: In our patient cohort, the raise of pain and sedation/agitation monitoring, has optimized analgesic and sedatives doses and improved clinical outcomes.

INTRODUCTION

The administration of analgesics and sedatives for the management of pain, anxiety, stress, agitation and delirium in adult critically ill patients is a common practice in intensive care units (ICUs), as it facilitates life support care [1]. However, inappropriate use of analgosedation [2-4], can prolong the duration of mechanical ventilation (MV), worsen the evolution and prognosis of the patient and increase the cost of healthcare [5]. These complications can be prevented by using validated scales which assess pain and sedation levels and revise analgosedation targets regularly [1,6]. These strategies would help critical-care professionals use the lowest effective dose and achieve optimal and safe analgosedation. American and European guidelines recommend routine pain and sedation assessment, as well as the use of analgosedation titration protocols based on nurse-driven standardized algorithms. Furthermore, guideline authors prioritize the use of analgesia over sedation, the administration of analgosedation through the use of algorithms and the selection of light sedation, whenever possible [7-10]. During the last decades, there has been a significant change in the culture of analgosedation practice [11]. However, implementing pain and sedation assessment guidelines and, more specifically, nurse-driven analgosedation protocols (ASP), entails a substantial change in clinical practice, as it gives the nursing staff greater autonomy and involves more intensive teamwork.

This investigation reports the first phase of implementation of a nurse-driven analgosedation protocol. This ASP standardizes routine pain assessment and sedation levels and establishes the use of analgosedation targets. Our aim was to improve the systematic monitoring of pain and sedation levels following the implementation of a nurse-guided ASP. It also assessed the achievement of targets for analgesic and sedation levels and finally, determine its influence on drug management and clinical outcomes of sedated patients with mechanical ventilation.

MATERIALS AND METHODS

Design and sample

An observational cohort study was conducted to compare a historical cohort (control group) and a prospective cohort (protocol group) of adult patients admitted to a 14-bed medical-surgical ICU in a tertiary hospital in Madrid, Spain. The study was approved by the Ethics Committee of our hospital. Prior to the extraction of data from clinical histories, informed consent was obtained from patients in the prospective cohort (or their relatives, when appropriate).

The control group was composed of patients admitted to this ICU between March 1, 2013 and February 28, 2014. Data was retrospectively collected from these patients. During this period, analgesia and sedation were provided according to traditional practice (i.e. without protocol-directed assessment).

The protocol group included patients admitted from March 1, 2014 to May 31, 2015. Study variables related to these patients were prospectively collected. During this period, targets and levels of analgosedation were assessed following a standardized analgosedation protocol [Figure 1]. Weaning from MV was performed at physician's discretion, following the same protocol during the study period. Inclusion criteria were: age ≥18 years, duration of MV ≥ 24 hours, and administration continuous infusion of sedation. Exclusion criteria were: patient's inability to speak or understand Spanish; patients transferred from another hospital where the patient was sedated and received MV ≥ 24 h; critical patients who are not in charge of the medical team from medical surgical ICU; adequacy of the therapeutic effort; pregnancy; convulsive status epilepticus, need of cardiopulmonary resuscitation, severe Central Nervous System (CNS) disease at admission with intracranial hypertension and/or Glasgow Coma Scale (GCS) ≤8 prior to intubation.

Intervention

Before the study began, nine training sessions about assessment and management of sedation and pain were held for nurses. An ad hoc questionnaire was given to doctors and nurses in order to raise awareness of the correct monitoring of pain, sedation and the implementation of nurse-led algorithms. In the control group, no standard assessment of analgesia or sedation was performed and no sedo-analgesia targets were established. Analgosedation was monitored (using a validated or non-validated scale) at the discretion of the charge nurse.

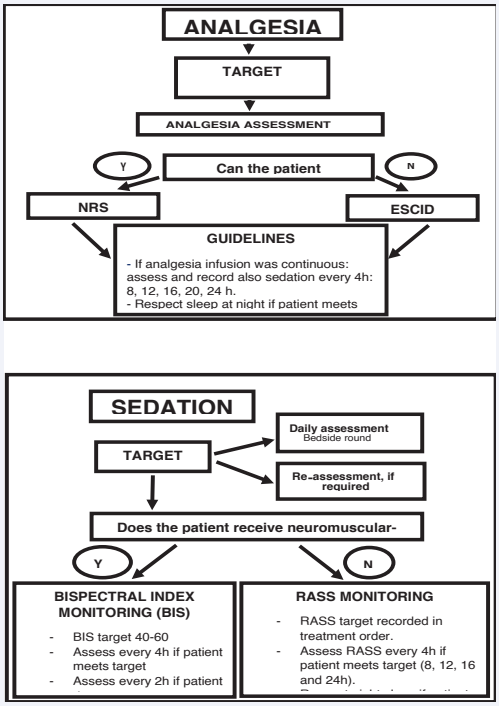

Figure 1 Algorithm for the assessment of analgosedation. NRS: Numerical Rating Scale; ESCID; Escala de Conductas Indicadoras de Dolor - Behavioural Indicators of Pain Scale; BIS: Bispectral Index; RASS: Richmond Agitation-Sedation Scale.

At the end of the data collection from the control group, a 15-day dissemination campaign was conducted among ICU doctors and nurses. Posters and brochures describing the rating scales to be used and pocket algorithms were distributed to staff to familiarize them with the new nurse-led analgesic sedation protocol. In the protocol group analgosedation levels and targets were standardized to improve analgosedation practices. A multidisciplinary Analgosedation Group was created and developed the ASP, which standardized analgosedation practices, incorporating algorithms for monitoring pain and sedation (with validated scales), drug choice, challenging sedation, as well as dose titration and weaning. In patients receiving continuous infusion of analgesia and sedation, analgosedation level was assessed at four-hour intervals (except at night to respect patients' rest) if targets were achieved, and at two-hour intervals if not. In patients receiving intermittent intravenous analgesia, it was assessed two hours prior to the next planned programmed administration of analgesics, in case rescue analgesia was needed to relieve pain [Figure 1]. Some of the nurses, who participated in the design of the ASP, performed different functions such as to guide ICU staff during implementation and collected daily data from the patient´s medical history. Adherence to the protocol was evaluated weekly by a research nurse using a checklist. After three months, the results of the checklist were analyzed and used to design a questionnaire about the process of implementation of the protocol. A summary of checklist results as well as the questionnaire were distributed to the nursing staff. The reasons it was done at this time were, firstly, to obtain an updated perspective of staff's opinion on the process of implementation and secondly, to identify barriers and potential improvement

measures. The results of the checklists and questionnaires were discussed with the nursing staff in 20 sessions of 40 min each. A session was specifically held with physicians. These feedback sessions helped us develop improvement measures that would increase staff's adherence to the protocol. These measures were aimed at enhancing nurse-physician communication and improving the quality of records on analgosedation assessment, results and targets. Measures to improve the implementation process: the goal of sedation of each and every patient was added to the medical treatment to ensure this information was always recorded; reporting sessions were incorporated to improve physician-nurse communication; communication was improved by routine change-of-shift reporting (nurses only) and joint bedside shift reporting (physicians and nurses); a daily therapeutic-target checklist (which included sedation target) was introduced for physicians and nurses to complete during morning joint reporting sessions. Finally, aspects related to analgesia and sedation were discussed during the nurse change-of-shift session.

Measurement

Demographic data was collected, namely: age, sex, Acute Physiology And Chronic Health Evaluation II, Therapeutic Intervention Scoring System 28, cause of admission (Respiratory, Neurological, Digestive, Infectious, Cardiovascular, Postoperative, Others), toxic habits (Yes/No), sedation duration (duration ≤72h, duration >72h), use of IV muscle relaxants (yes, no), Acute Lung Injury (yes, no). Records from analgosedation rating scales: number of records per tool, patients with scale records (Yes/No). Drug management: daily infusion dose (opiates, morphine, midazolam and propofol in mg/day, remifentanyl, fentanyl, dexmedetomidine and clonidine in mcg/day), drug use (Yes/No), use of analgesics (opiates, morphine, remifentanyl, fentanyl, tramadol, paracetamol, dexketoprofen, metamizol) and sedatives (midazolam, propofol, clonidine, dexmedetomidine). Clinical outcomes: four ventilation times (days), length of hospital and ICU stay (days), ICU and in-hospital mortality (Yes/No). Four ventilation times were measured as follows: mechanical ventilation time (MVT), defined as the number of days between the start of invasive mechanical ventilation in the ICU and the start of weaning. Weaning time (WT), defined as the number of days between the moment at which a support pressure ≤ 12 cmH2O was administered and the last attempt of spontaneous breathing using either a T-tube or a support pressure ≤ 8 cmH2O. Ventilatory support time (VST) was the sum of MVT and WT. Artificial airway time (AAT) was defined as the number of days the patient used an artificial airway in the ICU. Safety data: ventilator-associated pneumonia (Yes/No), reintubation for extubation failure (Yes/No), and cases of device self-removal (tracheostomy tubes, enteral tubes, central venous catheter, arterial catheters, peripheral venous catheters, urinary catheters, drains, others).

Data Collection

Data from patients included in control group were collected retrospectively by the research nurses from paper clinical records upon authorization of the hospital throughout 2014. In protocol group, the same nurses gathered prospective data on study variables from patients' charts on a daily basis. Analgosedation assessment and management was recorded in patient's charts by the ICU staff as part of routine care. Physicians recorded the sedation target using the Richmond Agitation-Sedation Scale (RASS) or the Bispectral index (BIS) in the treatment order. Analgesia target was incorporated in the protocol based on the Numerical Rating Scale (NRS) <3 or Escala de Conductas Indicadoras de Dolor- Behavioural Indicators of Pain Scale (ESCID) 0, [Figure 1].

Instruments

The scales used for standard pain and sedation assessment are recommended in clinical practice guidelines, and their validity, reliability and psychometric properties have been largely validated [7-10]. Level of sedation was assessed by the RASS [12], except for patients receiving neuromuscular blockers, whose level of sedation was measured by BIS [13]. RASS is a 10-point scale where 0 stands for an alert, calm patient. Positive values (+1 to +4) indicate level of agitation, whereas negative values (-1 a -5) indicate level of sedation. It is the most valid and reliable scale for assessing sedation [14] (Cronbach α = 0.989) [15]. BIS provides information on the patient's electroencephalographic activity for the past 60 seconds. The use of BIS is recommended for patients requiring deep sedation, such as patients receiving neuromuscular relaxants. BIS has a sensitivity of 85% and a specificity of 85.9% [16]. Pain was assessed by the NRS in patients who could communicate [17], and by ESCID [18], in patients who could not communicate. NRS is the standard tool used to assess pain intensity in patients who can communicate: the patient selects a number ranging from 0 (no pain) to 10 (pain as bad as you can imagine). NRS has a sensitivity of 94.3% and a specificity of 63.4% [19]. ESCID is a Spanish scale for assessing pain intensity in mechanically ventilated patients who cannot communicate that has been validated for surgical/medical patients (Cronbachα = 0.85). ESCID is a 5-item scale where each item is rated 0 to 2 points. Items includes facial expression, calmness, muscle tone, compliance with MV, and consolability, yielding a total score from 0 (no pain) to 10 (worse pain imaginable) [20].

Statistical Analysis

Quantitative data was expressed as means and standard deviation for normally distributed variables or otherwise as medians and interquartile range. Qualitative data were expressed as proportions and absolute values. Normality of distribution was assessed by the Kolmogorov-Smirnov test. Student's t-test was used for normally distributed continuous vs. categorical variables. Otherwise, Mann Whitney U test was used. Chi squared test was used for comparison of categorical variables with an expected frequency >5. When the expected frequency was <5, Fisher's test was performed. First, demographic and general data from members of the control and protocol groups were compared. Then, a comparative analysis was performed between the

Abbreviations: CCLS: Certified Child Life Specialist

frequency of scale-based assessments, drug management (dose and use); duration of MV; ICU and hospital length of stay; ICU and in-hospital mortality; and ventilator-associated pneumonia, reintubation, and device self-removal. After the initial analysis, it was decided to carry out a sub-analysis to know the impact of ASP on the duration of MV, excluding neurocritical patients and/or patients with neuromuscular relaxants. The reason for this sub-analysis is that analgosedation may have direct therapeutic implications in these patients and their ventilation times may be influenced by factors other than ASP. Finally, significance level was set at <0.05, with a 95% CI. All analyses were performed using the SPSS® version 21 software package.

RESULTS

A total of 1,338 patients were admitted to our unit during the study period (660 control group and 678 protocol group). As shown in the patient flow chart, 242 patients were finally included in the study, 105 control group patients' vs 137 protocol group patients, [Figure 2]. Both groups were homogeneous [Table 1]. Pain and sedation assessment improved with the implementation of the protocol. Scale assessment scores were recorded more frequently during the ICU stay, especially RASS scores [Table 2]. However, BIS was not recorded more frequently, as it was already monitored and recorded correctly before the protocol implementation. The proportion of patients in whom analgosedation was assessed using ESCID, NRS and RASS scales increased [Figure 3]. The daily dose of i.v. sedatives and analgesics decreased [Table 3], with significant reductions in the doses of midazolam (p=0.001) and propofol (p=0.04).

The implementation of the ASP changed the cumulative incidence of the use of analgesics and sedatives, decreasing the use of morphine and increasing the use of metamizol, paracetamol and dexmedetomidine (Supplementary material. S1). Ventilation time did not decrease significantly with the implementation of the ASP [Figure 4 and Figure 5], even after neurocritical patients and receptors of IV neuromuscular blocking agents were excluded [Table 4]. The incidence of ventilator-associated pneumonia (VAP) decreased [27(25%) vs 19(14%); p=0.02] in the protocol group. In contrast, the incidence of reintubation due to extubation failure did not change significantly [16(15%) vs 13(9%); p=0.45]. The incidence of device self-removal was similar in the two groups [27 (26%) vs 29 (21%); p=0.57], despite titration of analgesics and sedatives and the longer duration of the protocol group. Supplementary material (S2) shows cases of self-removal by type of device. The devices most frequently removed were enteral [21 (20%) vs 18 (13%); p=0.19] and tracheal tubes [4 (4%) vs 6 (4%); p=1]. In the control group, ICU and hospital stays did not change significantly. Yet, a significant decrease (p=0.01) was observed in ICU mortality [Table 4].

DISCUSSION

There is evidence [21-38], of the benefits of nurse-driven analgosedation protocols for critical patients and in this same line, we can say, that the results of our research, seem to indicate that during the initial phase of implementation of our protocol,

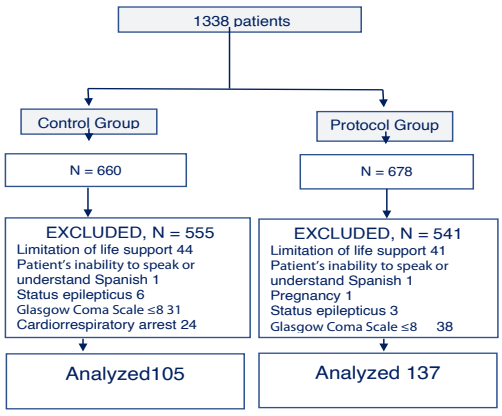

Figure 2 Patient flow chart

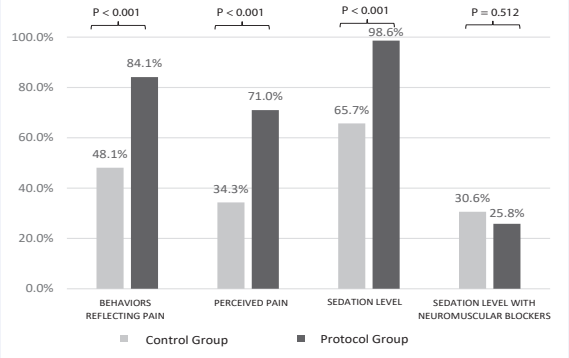

Figure 3 Changes pain and sedation assessment before and after protocol.

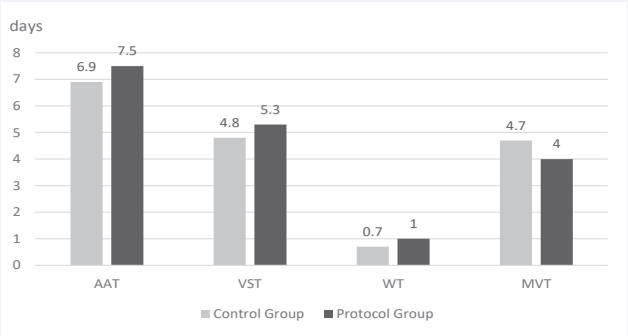

Figure 4 Ventilation times. Artificial Airway Time (AAT), Ventilatory Support Time (VST), Weaning Time (WT), Mechanical Ventilation Time (MVT). Without significant differences (p>0.05)

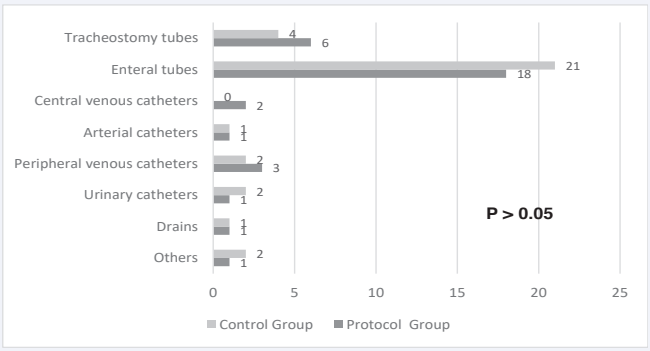

Figure 5 Cases of device self-removal.

Table 1: Patient characteristics.

	CONTROL GROUP N=105	PROTOCOL GROUP N=137	P
Age Mean (SD)	55.93 (14.61)	54.57 (15.34)	.48
Female sex n (%)	22 (21)	60 (44)	.38
APACHEII Mean (SD)	19.21 (6.89)	18 (6.47)	.15
TISS28 Mean (SD)	41.35 (10.43)	39.48 (9.55)	.14
Admission Category n (%) Respiratory Neurological Digestive Infectious Cardiovascular Postoperative Others	 22 (21) 25 (24) 15 (14) 24 (23) 2 (2) 8 (8) 9 (8)	 42 (31) 43 (31) 9 (7) 24 (17) 2 (1) 9 (7) 8 (6)	.20
Toxic habits n (%)	30 (28)	47 (34)	.29
Sedation n (%) Duration ≤72h Duration >72h	 26 (25) 79 (75)	 39 (28) 98 (72)	.51
Use of muscle relaxants n (%)	28 (26)	41 (30)	.54
ARDS or ALI n (%)	25 (24)	28 (20)	.53

Legend: SD: Standard Deviation; APACHEII: Acute Physiology and Chronic Health Evaluation II; TISS28: Therapeutic Intervention Scoring System 28; ARDS: Acute Respiratory Distress Syndrome; ALI: Acute Lung Injury.

Table 2: Assessment outcomes

RECORDS	TOOL	CONTROL GROUP N=105	ROTOCOL GROUP N=137	P
Pain level	ESCID Median (IQR)	0 (0 - 3)	3 (1 - 6)	<.001
	NRS Median (IQR)	0 (0 - 1)	2 (0 - 4)	<.001
Sedation level	RASS Median (IQR)	3 (0 - 13.7)	19 (8 - 31)	<.001
	BIS Median (IQR)	0 (0 - 6.7)	0 (0 - 5)	.651

Legend: ESCID: Escala de Conductas Indicadoras de Dolor – Behavioural Indicators of Pain Scale, NRS: Numerical Rating Scale, RASS: Richmond Agitation-Sedation Scale, BIS: Bispectral index, IQR: Interquartile Range.

the systematic evaluation of the level of pain, level of sedation and proposed objectives, can improve the clinical results of patients and the quality of analgosedation practice. Regarding the management of analgesia, agents other than those traditionally used such as metamizol and paracetamol were integrated in routine analgesia. For the control group, tramadol was virtually the only analgesic administered. In protocol group, rescue medications (paracetamol and metamizol) were integrated into the tramadol-based analgesic regimen. Also, fentanyl and remifentanil were promoted over morphine. As reported in previous studies, trends were observed in the dose of sedatives and analgesics to decrease, except for fentanyl [26,30].

More specifically, the doses of midazolam and propofol, the most common sedatives used in critical care, diminished significantly [Table 3]. Dexmedetomidine was introduced into the portfolio of sedatives of our Unit by the end of the pre-intervention period. Being of restricted use, it was included in the therapeutic decision-making algorithm for control of delirium and refractory agitation. As a result, the use of dexmedetomidine increased in our Unit. The results of this study are consistent with previous studies reporting that nurse-led ASPs optimize analgosedative dosage [21,22,26-28,30,37,38].–In our study, ventilation times did not decrease as significantly as in other studies [21-27,29,31-34,36-38]. This may be due to the increase in weaning times and artificial airway duration observed in protocol group due to the substantially higher number of neurocritical patients treated in this period. For this reason, neurocritical patients and patients who received neuromuscular blocking agents were excluded from subanalysis. Neurocritical patients generally need deep sedation, the duration of sedation is longer, and weaning occurs later. These patients often exhibit polyneuropathy and require a tracheostomy. These factors may augment the variability and duration of MV. Thus, patients with a tracheostomy, receiving muscle relaxants, liver/kidney failure and/or drug abuse were excluded in previous studies [24,28-30,34, 36,38]. Although these patients may have benefited from the intervention, their presence may explain the greater variability obtained in ventilation times. While ventilation times did not decrease, the incidence of VAP decreased, as reported in other studies [25-26,28]. In line with other studies [29,34], reintubation episodes did not decrease. Our results contradict those of Quenot et al. [26], who reported a significant reduction. Numerous studies report a decrease in ICU and hospital length of stay associated with the use of nurse-driven protocols [24, 28-30, 34,36,38]. Yet, as reported in other studies [28,34,35], a decrease was not achieved in our study. The impact of ASPs on mortality has been extensively studied. In agreement with our results, some studies show a decrease in mortality [23,27,34,36] while others do not document a decrease [26,28,31,35]. This reduction may not be only caused by implementation of ASPs, even though significance has been reached by univariate analysis. At present, only two studies conducted in Australia have failed to demonstrate that ASPs improve the quality of analgosedation [39,40]. These studies show a non-significant increase in ventilation times and hospital LOS. However, Bucknall et al. [39], identified several factors that could have conditioned its results. It is a single-center study where all nurses implemented both, the traditional and the

Table 3: Daily I.V. analgesic and sedative dose.

DAILY I.V. DOSE Median (IQR)	N	CONTROL GROUP	N	PROTOCOL GROUP	P
Analgesic Opiates mg/day(1) Remifentanil mcg/day Morphine mg/day Fentanyl mcg/day	 92 39 82 8	 43.27(27.13-105.08) 2082 (1240-3200) 31.34 (23-43.47) 195 (100-225)	 124 57 85 20	 48.73 (25.44-100.31) 1666.62(857.53-3177.14) 28.63 (21.81-39.45) 339.62 (90.64-1142.31)	 .993 .181 .346 .383
Sedatives Midazolam mg/day Propofol mg/day Dexmedetomidine mcg/day Clonidine mcg/day	 73 93 3 22	 318 (231.26-452.67) 1930 (1045-2589) 1159.31(1105-1488) 491.27 (362-590.18)	 87 122 22 32	 223 (152.81-549.23) 1650 (845.82-2090) 869 (694-1357) 470.26 (304.63-605.34)	 .001 .041 .224 .554

Legend: IQR: Interquartile Range. (1) Doses of opiates include doses of morphine, fentanyl and remifentanil. Based on morphine dose equivalency (mg/day): fentanyl (mcg/día) x 0.1 and remifentanil (mcg/day) x 0.05.

Table 4: Clinical outcomes

CLINICAL OUTCOMES	CONTROL GROUP	PROTOCOL GROUP	P
Total sample	N = 105	N = 137	
ICU stay days Median (IQR)	11 (7 - 19)	11 (7 - 18)	.73
Hospital stay days Median (IQR)	30.51 (18 - 55)	25 (16 - 41)	.21
ICU Mortality n (%)	14(13)	6(4)	.01
Hospital mortality n (%)	17(16)	13(10)	.14
Excluded: neurocritical and relaxed patients.	n = 57	n = 61	
Days of Mechanical Ventilation Time Median (IQR)	4 (1.61 - 9.32)	2.44 (1.43 - 6)	.06
Days of Weaning Time Median (IQR)	0.65 (0.09 - 2)	0.54 (0.01 - 2)	.50
Days of Ventilatory Support Time Median (IQR)	4.27 (1.79 - 8.81)	3 (1.74 - 7.16)	.21
Days of Artificial Airway Time Median (IQR)	5.13 (2.71 - 10.84)	4.85 (2 - 8.91)	.22

Legend: IQR: Interquartile Range.

nurse-driven analgosedation protocol, which could have caused bias. In addition, the nurse's usual practice gave some autonomy for dose adjustment, although it was not protocolized. Almost all studies on ASP implementation are before-after studies [22-29, 31-35, 37-38, 40]. Except for four randomized trials [21,30,36,39] only a meta-analysis [41], has been performed to assess the efficacy of nurse-driven ASPs vs. standard practice. Yet, only two of these trials were included in the meta-analysis [21,39], without significant differences between the two strategies. Driving a cultural change in critical care is challenging. New analgosedation practices require that ICU teams receive specific training and education and imply teamwork and a change in work organization. The translation of evidence into clinical practice is a long, complex process. Although its use is increasing, and consistent evidence of their associated significant benefits [21-38], has been provided, the implementation of ASPs has not yet become a common practice (40-60%) [42-44]. More specifically, the use of ASPs barely reaches 53% in Europe [45], and in Spain [46], by 36%. The ASCyD study [46], carried out in 158 spanish intensive care units, shows that although pain and sedation monitoring Is around 50-70% respectively, only 8% of intensive care units have algorithms guided by nurses. The implementation of an ASP is hindered by numerous barriers[44] among which ICU staff's lack of specific training is of special relevance. The figure of advanced practice nurses or ICU nurse specialists does not exist in Spanish ICUs. To improve adhesion to ASPs, some authors recommend the use of measures that facilitate the transfer of knowledge including, but not limited to, training sessions, audits, providing feedback about results, identification of challenges, bedside rounds, and daily target checklists [47]. The presence of an ASP or practice guidelines does not guarantee its implementation or the improvement of clinical outcomes, as demonstrated by Luetz et al. [48], and Salluh et al., [43]. In their survey among 1,015 intensivists, Salluh et al. [43], found that 52.7% reported to have an ASP established in their unit, which were routinely implemented in only 21% of cases. In addition, 85.6% recognized that oversedation was frequent. More recently, Luetz et al. [48], conducted a European survey in 101 ICUs using a prevalence cutoff of 868 patients. The study revealed that although 88% and 80% of units had established a sedation and pain monitoring protocol, respectively, these were not monitored in 57% of patients; 22% of patients reported to have experienced moderate-to-severe pain, and 74% received moderate to deep sedation. As in other studies, specific awareness-raising and training strategies were used to improve adherence to the ASP [25,27,32,34]. Multiple communication strategies were adopted, and improvement measures based on ICU staff's feedback were applied during protocol implementation. The problems identified during routine practice were frequently solved with improvement measures proposed by the ICU staff. For an ASP to be correctly implemented, it is necessary that validated assessment scales are used to adjust analgosedative therapy to the target established. Doses can be adjusted by the nursing staff using algorithms. Yet, in the first phase of our study, titration was finally made by physicians, as they were reluctant to delegate this responsibility to the nursing staff. Although the awareness-raising questionnaires revealed that physicians acknowledged that dose adjustment can be done by nurses using algorithms (75%), they did not finally delegate this responsibility to the nursing staff. We may explain physicians' distrust by the nurse-to-patient ratio in Spanish ICUs, as 1:2, 1:3 and even 1:4 ratios have been documented [46,49]. Moreover, as mentioned above, there are not critical-care nurse specialists in ICUs in Spain, although they can obtain a PhD. As this study demonstrates, the lack of critical care nurses in Spain can be overcome by using a training plan and an implementation strategy that improves teamwork. Critical care nurses can detect and meet patient's analgosedation needs at bedside [21-38]. Hence, teamwork and team decision-making based on respect and trust on nursing staff's judgment and physician's willingness to delegate responsibilities, when appropriate, are of paramount importance. Nurse-led ASPs enables rapid bedside decision-making, prevents delays in the administration of therapies and ensures standardized care, which ensures safe analgosedation. Nurses perceive that the quality of critical care and their autonomy improve with ASPs. Over time, they get familiar with the protocol and find it easy to use [50,51]. Bias associated with our study design could be a limitation of this study. Selection bias may have occurred as data were obtained retrospectively by the examination of clinical records that were not digitized; as a result, some clinical records may have been lost. In addition, the study was single center. In this study, the training plan was developed before the control group, whereas the ASP was implemented during the protocol group. In other studies, the training plan and the ASP were implemented between the two observational periods [25-27,32]. These factors may have affected the magnitude of results. On the one hand, traditional practice may have changed after the training plan and on the other, the learning curve may have influenced the results of ASP negatively, as it was implemented during the protocol phase. We thought it would have been interesting to compare the pain and sedation levels of patients in both groups,

but records of pain and sedation scores were very sparse in the control group. The incorporation of dexmedetomidine by the end of the control group may have caused an increase in the administration of light sedation during the post-intervention period. However, the use of this drug was restricted to patients with delirium and refractory agitation caused by other therapies. As we evaluated the results of the initial phase of implementation of an ASP, univariate analysis was performed for the preliminary study. Multivariate analysis was put off for a later stage.

CONCLUSIONS

This study demonstrates that analgosedation practices improve when a protocol is established, even from its early stage of implementation. The quality of analgosedation practices improved with the use of a standardized analgosedation assessment and target-oriented protocol: increased analgesia and sedation monitoring frequency, reduced sedation dosage and VAP, with no change in days on mechanical ventilation, reintubation, device self-removal and hospital LOS. Yet, further research is needed to achieve optimal dose adjustment based on the use of nurse-driven analgosedation algorithms. Intensive research should be conducted to find the best method for preventing and assessing delirium and achieve early mobility. All these measures together will ensure maximal comfort and optimal outcomes in critical patients.

MANUSCRIPT CONTRIBUTIONS

What is already known about the topic?

The implementation of this protocol involves a paradigm shift. Firstly, it implies changing traditional analgesia and sedation practice, where analgesia and light sedation are given priority. Secondly, it entails a dramatic change in work organization, as it gives the nursing staff greater autonomy and promotes communication and teamwork. The translation of evidence into clinical practice is a long, complex process. Hence, although the efficacy of these protocols was first demonstrated in 1999 Brook et al. [21], numerous measures based on the extensive bibliography and contemplated in the latest clinical practice guidelines have been incorporated into different protocols only a few studies have been realized in Spain demonstrating it.

What this paper adds?

A factor that has hindered, the translation of evidence into practice in Spain is the absence of nurse specialists and advanced practice nurses in multidisciplinary intensive care teams. Although there are PhD nurses in our ICU units, they are not integrated in critical care practice. However, this difficulty can be resolved with a correct training, dissemination and continuous improvement of the process of implementation of these protocols.

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