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Sedation and analgesia in German intensive care units: how is it done in reality? Results of a patient-based survey of analgesia and sedation

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Abstract *Objective:* This study carried out the first patient-oriented survey on the practice of analgesia and sedation in German intensive care units, examining whether the goals of early spontaneous breathing and awake, cooperative patients are achieved. *Design:* A postal survey was sent to 261 hospitals in Germany. Each hospital received three patient-oriented forms with questions regarding current agents and techniques for analgesia and sedation of a specific patient. Responses were obtained from 220 (84%) hospitals which returned 305 questionnaires. *Results:* Patients' Ramsay sedation scale was significantly higher in all phases of analgesia and sedation, indicating that the patients were more deeply sedated than currently intended by the therapist. Propofol was used for most of the patients during short-term sedation (57%) and during weaning (48%). The preferred agent for sedation longer than 72 h was midazolam (66%). *Conclusion:* The choice of agents and techniques for analgesia and sedation in the intensive care unit thus follows the German guidelines. The fact that the patients were more deeply sedated than intended by the therapist in all phases of sedation may be due to the low use of sedation scales and clinical practice guidelines or to the lack of training in using these techniques.

Keywords Sedation · Analgesia · Scores · Intensive care unit · Survey

Introduction

Critical care therapies such as ventilation, invasive procedures, and other measures inducing pain or stress require analgesia and sedation of the patient. Adequate analgesia and sedation is supposed to prevent stress-induced reactions [1, 2, 3] and to optimize patient comfort. Goal-oriented analgesia and sedation [4, 5] with the use of clinical practice guidelines, scoring systems, and targeted selection of agents for analgesia and sedation of the intensive care patient achieves an early spontaneous breathing [6], and with it a quick weaning and shorter stays in the intensive care unit [7]. German guidelines for analgesia and sedation recommendations for the different phases of analgesia and sedation are based upon the available literature [8]. Sedation that

is too deep can have negative side effects [9, 10, 11] including increased risk of venous thrombosis, bowel motility problems, hypotension, and a prolonged stay in the intensive care unit (ICU), which result in increased costs [12, 13, 14]. The use of scoring systems is a substantial part of a patient-oriented analgesia and sedation. The administration of agents for analgesia and sedation can be properly controlled only by specifying the level of analgesia and sedation and monitoring it with scoring systems. The requirements for an ideal analgesia and sedation are the ability to sedate the patient deeply for necessary procedures, but with medication of short duration so that the patient can be quickly responsive and cooperative [4]. Martin et al. [15] showed in their survey about the practice of analgesia and sedation that only 8% of German ICUs use scoring systems routinely to monitor analgesia and sedation. Soliman et al. [16] conducted a survey in 16 European countries on the current practice of sedation. They found distinct differences between countries in the practice of analgesia and sedation. The most commonly used medication for continuous sedation in Europe is midazolam, whereas in the United States in 2002 the Society of Critical Care Medicine [17], recommended midazolam and propofol as the preferred medication for short-term sedation and lorazepam for long-term sedation. The preferred analgesics in English-speaking countries are morphine and fentanyl.

The goal of the present survey was to determine the current practice of analgesia and sedation in German ICUs run by anesthesiologists and compares these to the recommendations of the German evidence and consent-based guidelines. In contrast to all prior surveys, participants of the study were advised to collect the data at the patient's bedside. This makes it possible for the first time to assess whether the demands on modern analgesia and sedation in ICUs are achieved.

Materials and methods

We selected a simple random sample of one-third of the addresses (254 general hospitals and 15 university ICUs) from an address database of the German Society for Anesthesiology and Intensive Care Medicine (Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin) that contains a total of 808 addresses of ICUs run by an anesthesiological department (45 university hospitals and 763 general hospitals). The letter proved undeliverable in the case of eight hospitals although it was sent up to four times to the hospitals between May and October 2002. Questions concerned the structure and procedures for analgesia and sedation for every department. Three patient-oriented questionnaires were included, and participants were asked arbitrarily to select one to three patients who were presently under sedation and to include them in the study, with the forms being filled in at the patient's bedside. This was left to the discretion of the physician. For organizational reasons neither the time nor the day of the data collection was predetermined. To maximize return rate the study was designed to leave it open to the participants of the survey.

Participants were asked about the agents used and the desired depth of sedation. Data regarding depth of sedation were to be specified on the Ramsay et al. [18] sedation scale (RSS) which was part of the assessment form; translation of the scale into German is published in the German S2e guidelines for analgesia and sedation [8]. Both the desired and the actual depth of sedation were to be determined, the latter at the patient's bedside. Only the desired depth of sedation for most of the day was asked. The length of sedation was categorized according to American [17] and German guidelines [8]: shorter than 24 h ("short-term sedation"), 24–72 h ("medium-term sedation"), longer than 72 h ("long-term sedation"), and during weaning from ventilation ("weaning sedation"). Table 1 presents patients' clinical characteristics in each

Table 1 Demographic and basic data of the patients, classified by length or type of sedation (*ASA* American Society of Anesthesiologists, *SOFA* Sepsis-Related Organ Failure Assessment, *CI* 95% confidence interval)

	< 24 h (n = 42)	24–72 h (n = 49)	> 72 h (n = 157)	Weaning (n = 57)
Age, median (years; range)	63.5 (14–88)	67 (11–91)	65 (19–97)	66 (18–90)
Sex: M/F	25/17	25/24	98/59	45/12
SOFA, median (range)[a]	4 (0–10)	6 (0–16)	10 (0–20)	6 (0–17)
ASA classification, median (range)	3 (0–4)	3 (0–4)	3 (0–4)	3 (0–4)
Patients with renal replacement therapy	1 (2%)	1 (2%)	21 (13%)	8 (14%)
Oral intubation (CI)	95.2% (88.6–101.8)	98% (94.0–102.0)	63.1% (53.6–72.6)	50% (31.5–68.5)
Tracheotomy (CI)	0	0	32.5% (19.6–45.3)	48.2% (29.4–67.1)
Nasal intubation (CI)	4.8% (−24.8 to 34.3)	2% (−5.7 to 29.8)	4.4% (−10.8 to 19.8)	1.8% (−24.2 to 27.7)

[a] $p < 0.025$: < 24 vs. 24 h–72 h, < 24 vs. > 72 h, < 24 h vs. weaning, 24 h–72 h vs. > 72 h, > 72 vs. weaning: $p = 0.39$: 24 h–72 h vs. weaning (Mann-Whitney *U* test)

of the categories of sedation. Age, sex, American Society of Anesthesiologists physical status classification, and number of renal replacement therapies did not differ significantly between groups (Table 1). Groups differed significantly in Sequential Organ Failure Assessment (SOFA) score [19]. Patients receiving long-term or weaning sedation had significantly more renal replacement therapies. Any interventions such as nursing activities were to be avoided during the monitoring of sedation. No daily wake-up trial was requested in the questionnaire. No hospital even mentioned this in the comments to the questionnaire.

Questionnaires were returned by 220 of the 261 departments (84%), and 305 patient-oriented forms were received. At this response rate the possibility of non-responder bias is negligible (standard 2–2, NCES Statistical Standards; http://nces.ed.gov/statprog/2002/std2_2.asp). The data were collected in a Microsoft Access 97 database and analyzed with the programs Microsoft Excel 9.0 and SPSS for Windows version 10.07. Univariate statistical analyses were carried out depending on the scaling of the data using either the Mann–Whitney U test or the χ^2 test. The analyses were to be understood as exploratory, and therefore no multiple adjustments were carried out. Statistical Significance (in the sense of exploratory analyses) was set at the $p > 0.05$ level.

Results

The actual depth of sedation was found to be significantly deeper than desired in each of the four groups (Fig. 1): in 62.4% of those under short-term sedation, 42.6% of those under medium-term sedation, 39.5% under long-term sedation, and 43.9% of those under weaning sedation (Fig. 2). Only in the long-term and weaning sedation groups was the RSS value in some of the patients lower than the desired value: 5.2% and 3.5%, respectively
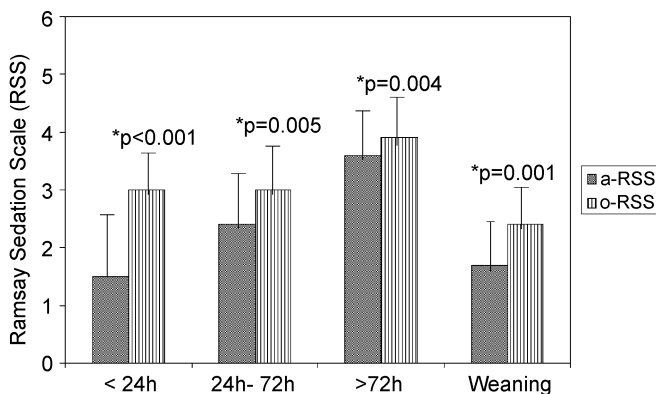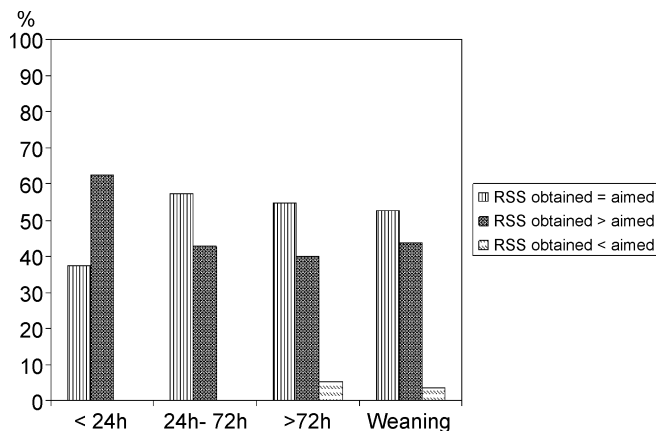
Fig. 2 The desired Ramsay sedation scale value vs. a higher or lower value. Proportion of patients in the different phases of analgesia and sedation that obtained the desired value on the Ramsay sedation scale (*RSS*) vs. the proportion that obtained a higher or lower value on the RSS

(Fig. 2). Among patients under long-term sedation the desired RSS value was 0, 2, or 3 in 44% of cases, but the desired value was achieved in only 28% of these; in 55% of cases the desired value was 4 or 5, but the desired value was achieved in only 68%; and in 1% of cases a value of 6 was desired, but this was achieved in only 6%.

As a continuous agent propofol (57%) was used significantly more often than midazolam for short-term sedation (36%; $p = 0.005$, χ^2) and for weaning sedation (48% vs. 34%; $p = 0.03$, χ^2), for long-term sedation midazolam was used more often (66.2%; $p < 0.001$, χ^2), while in the group receiving medium-term sedation there was no difference (Table 2). For short-term analgesia piritramide was used significantly more often (50%) than fentanyl (10%) and sufentanil (24%). In all other groups sufentanil was administered more often than fentanyl and piritramide ($p < 0.05$, χ^2; Table 2). Central neuroaxial blockade with an epidural catheter was used significantly more often during analgesia and short-term sedation (14%) than in long-term (1%) and weaning sedation (5%). There was also a significant difference between the groups receiving medium-term (12%) and long-term sedation (1%; $p < 0.05$; χ^2 Table 2). As adjuvant technique for analgesia and sedation clonidine was used in 39% of patients under sedation during weaning, which differed significantly from the practice in the other groups ($p < 0.05$, χ^2, Table 2). Nonsteroidal anti-inflammatory drugs were used significantly more often in short-term (17%) than long-term sedation (3%); there was no difference between the other groups. In the long-term sedation group ketamine (S) was administered significantly more often (12%) than in the short-term (5%) and weaning sedation patients (5%; $p < 0.05$, χ^2 Table 2).

Fig. 1 Mean SD of the value on the Ramsay sedation scale that which aimed at (*a-RSS*) and that which was obtained (*o-RSS*). *$p \leq 0.05$ (Mann-Whitney U test)

Table 2 Proportion of agents and techniques in the different phases of analgesia and sedation (*GHBA* γ-hydroxybutyric acid, *NMBAs* neuromuscular blocking agents, *NSAIDs* nonsteroidal anti-inflammatory drugs, *PCA* patient-controlled analgesia, *parentheses* 95% confidence interval)

	< 24 h (*n* = 42)	24 h to 72 h (*n* = 49)	> 72 h (*n* = 157)	Weaning (*n* = 57)
Midazolam	35.7 (11.5 to 60.0)	42.9 (21.7 to 64.0)	66.2 (57.2 to 75.3)	33.9 (12.6 to 55.2)
Propofol	57.1 (37.3 to 77.0)	53.1 (33.9 to 72.2)	29.9 (16.8 to 43.0)	48.2 (29.4 to 67.1)
Methohexital	0	2.0 (−25.7 to 29.8)	1.3 (−14.3 to 16.8)	1.8 (−24.2 to 27.7)
GHBA	0	0	1.9 (−13.6 to 17.4)	5.4 (−20.1 to 30.8)
Diazepam	2.4 (−27.5 to 32.3)	0	1.3 (−14.3 to 16.8)	1.8 (−24.2 to 27.7)
Neuroleptics	2.4 (−27.5 to 32.3)	2.0 (−25.7 to 29.8)	0	7.1 (−18.1 to 32.4)
Flunitrazepam	0	0	0	3.6 (−22.2 to 29.3)
Fentanyl	9.5 (−19.2 to 38.3)	20.4 (−4.6 to 45.4)	30.6 (17.5 to 43.6)	16.1 (−7.9 to 40.1)
Sufentanil	23.8 (−2.6 to 50.2)	34.7 (12.1 to 57.3)	43.3 (31.5 to 55.1)	35.7 (14.7 to 56.7)
Piritramid	50.0 (28.6 to 71.4)	18.4 (−6.9 to 43.7)	6.4 (−8.8 to 21.5)	8.9 (−16.1 to 33.9)
Remifentanil	0	6.1 (−21.0 to 33.3)	0	1.8 (−24.2 to 27.7)
Ketamine (S)	4.8 (−24.8 to 34.3)	10.2 (−16.3 to 36.7)	12.1 (−2.6 to 26.8)	5.4 (−20.1 to 30.8)
NSAIDs	16.7 (−10.9 to 44.3)	8.2 (−18.7 to 35.0)	2.6 (−12.9 to 18.0)	7.1 (−18.1 to 32.4)
Morphine	0	4.1 (−23.3 to 31.5)	2.6 (−12.9 to 19.0)	10.7 (−14.0 to 35.5)
Other analgetics	19.1 (−8.2 to 46.3)	0	0	7.1 (−18.1 to 32.4)
Epidural	14.3 (−13.7 to 42.3)	12.2 (−13.9 to 38.5)	1.3 (−14.3 to 16.8)	5.3 (−20.1 to 30.8)
Clonidine	2.4 (−27.5 to 32.3)	8.2(−18.7 to 35.0)	14.7 (0.2 to 29.1)	39.3 (18.9 to 59.7)
PCA	0	0	0	1.8 (−24.2 to 27.7)
NMBAs	2.4 (−27.5 to 32.3)	2.0 (−25.7 to 29.8)	3.2 (−12.2 to 18.6)	0

Discussion

As demonstrated by this study, the actual RSS in a substantial proportion of patients in all phases of analgesia and sedation is higher than which is aimed at, indicating a level of sedation that is deeper than desired. The setting of sedation goals contributes substantially to achieving a goal-oriented sedation [5, 20]. Recent studies show that close monitoring with the help of scoring systems lead to a reduction in the length of stay in the ICU and in hospital [20]. Technical methods such as the bispectral index and auditory evoked potential monitoring were not used in any patient in our survey [21, 22, 23]. The use of scoring systems is also not very well established in Germany; current studies cite a range of 8 to 49% for their use [15, 16]. A new finding of the present study is that even despite the use of scoring systems patients often do not achieve the desired sedation.

The most likely reason for this inadequate use of the RSS is a training deficit. Indicative is the information that a RSS value between 1 and 2 is aimed at during short-term and weaning sedation. Among those receiving long-term sedation the desired RSS was 4 or less in 44% of patients; however, this value was actually achieved in only 28% of those patients. This is confirmed by the data reported by Otter et al. [24] and Kress et al. [20] that patients profit from lower RSS values even during long-term sedation. This information is worrying, considering that a sedation scale obviously cannot be used without training, and that the implementation of an adequate sedation is outcome relevant. Thus both oversedation [20] and undersedation may therefore have an impact on the complication rate, ICU length of stay, and lethality [25]. The German guidelines that show grade B for the use of scoring systems [8] are helpful in establishing evidence-based medicine, but we cannot assume that evidence-based guidelines may be put into action without training of technical and nontechnical skills [26].

Another aspect of poorly implemented sedation skills is indicated by the fact that only 20% of German ICUs have a written procedure instruction [15]. In the 1987 survey of ICUs in the United Kingdom by Bion et al. [27] 40% of respondents stated that they had established a formal procedure for sedation. Other surveys have shown that the use of clinical practice guidelines permits a decrease in the duration of sedation and ventilation and thus a reduction in costs [27, 28]. Mascia and coworkers [29] showed that duration of ventilation and length of ICU and overall hospital stay decrease only with the use of written clinical practice guidelines.

Implementing concepts for medication at a national level appears to be much easier. Propofol is recommended in the American [17] and German guidelines [8] for short-term sedation, and for long-term sedation lorazepam is recommended in the American guidelines and midazolam in the German guidelines. In our survey the most commonly used agent for short-term sedation and for weaning from ventilation was propofol. Midazolam was used mainly for long-term sedation. Lorazepam, recommended in the American guidelines [17] for long-term sedation, was not used by any department. Whereas the American guidelines recommend fentanyl, hydromorphone, and morphine for analgesia in all phases [17], we found piritramide to be used preferably for short-term analgesia. This German preference is based on the view that piritramide achieves a lower incidence of nausea and vomiting than morphine [30]. In all other phases

sufentanil was preferred. While the United Kingdom survey [31] in 2000 found that alfentanil was very often used, this opioid did not play a role in German ICUs. Our results correspond to those of the European-wide survey by Soliman et al. [16] and the German survey by Martin et al. [15]. The actual practice of pharmacological analgesia conforms with the German guidelines [8].

Central neuroaxial techniques during sedation were most often used during short-term (14%) and medium-term sedation (12%). The studies by Brodner et al. [32] and by Beattie et al. [33] and the meta-analysis by Rodgers et al. [34] showed that perioperative use of epidural analgesia shortens ICU length of stay and reduces the incidence of cardiac and pulmonary events. The use of epidural analgesia during analgesia and sedation in the intensive care unit is recommended in the German guidelines. Clonidine as an adjuvant for sedation was preferably used in patients during weaning (39%). A reasonable use of this agent during weaning was shown by Walz et al. [35]. Bohrer and coworkers [36] reported that the requirements for opioids and sedation may be reduced with the use of clonidine. We found that ketamine (S) is most often used during long-term sedation. Only few studies have examined long-term sedation with ketamine, as demonstrated by Ostermann et al. [37] in their review. One important reason for the use of ketamine is the low effect on bowel motility [38].

Nonsteroidal anti-inflammatory drugs were used preferably during short-term sedation (17%). The low use of these agents can be explained by its spectrum of side effects [8]. Neuromuscular blocking agents were only rarely used in all phases of analgesia and sedation. The German guidelines provide no recommendation for the use of neuromuscular blocking agents in the scope of analgesia and sedation in ICUs [8]. Nasal intubation is only rarely performed. Our results show that the number of tracheotomized patients increases with the duration of ventilation. Rumbak et al. [39] showed that in patients who are ventilated for a prolonged time mortality is lower once they are tracheotomized than in patients who are intubated.

One of the limitations of this study was that the survey was carried out only in ICUs run by a department of anesthesiology. No data were collected from ICUs run by other specialties. Hack and colleagues [40] showed that most interdisciplinary ICUs in general hospitals in Germany are run by departments of anesthesiology.

Conclusion

For the first time in a survey on analgesia and sedation current patient data were collected which present a realistic view of the practice of analgesia and sedation. We found that German ICUs run by anesthesiologists administer mainly propofol as a short-acting agent, and that for long-term sedation the benzodiazepine midazolam is used. As a German preference for analgesia during short-term sedation piritramide is used and in the other phases the opioid sufentanil. The epidural analgesia is preferred postoperatively during short-term sedation. As an adjuvant agent during weaning clonidine is used most often. Nonsteroidal anti-inflammatory drugs play only a minor role for analgesia and sedation.

This survey shows that the guidelines for pharmacological analgesia and sedation [8] are implemented as far as possible. However, a proportion of patients in all phases are more deeply sedated than desired. This is explained by the fact that only a small part of the hospitals have a written procedure instruction or a scoring system to monitor the analgesia and sedation established as the survey of Martin et al. [15] showed. Numerous publications have shown that the consistent use of these methods after prior training avoids sedation that is too deep and may reduce the time of ventilation and length of stay in the intensive care unit [20, 27, 30].

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