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## Physical restraint in mechanically ventilated ICU patients: a survey of French practice

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**Abstract Purpose:** To characterize the perceived utilization of physical restraint (PR) in mechanically ventilated intensive care unit (ICU) patients and to identify clinical and structural factors influencing PR use. **Methods:** A questionnaire was personally handed to one intensivist in 130 ICUs in France then collected on-site 2 weeks later. **Results:** The questionnaire was returned by 121 ICUs (response rate, 93 %), 66 % of which were medical-surgical ICUs. Median patient-to-nurse ratio was 2.8 (2.5–3.0). In 82 % of ICUs, PR is used at least once during mechanical ventilation in more than 50 % of patients. In 65 % of ICUs, PR, when used, is applied for more than 50 %

of mechanical ventilation duration. Physical restraint is often used during awakening from sedation and when agitation occurs and is less commonly used in patients receiving deep sedation or neuromuscular blockers or having severe tetraparesis. In 29 % of ICUs, PR is used in more than 50 % of awake, calm and co-operative patients. PR is started without written medical order in more than 50 % of patients in 68 % of ICUs, and removed without written medical order in more than 50 % of patients in 77 % of ICUs. Only 21 % of ICUs have a written local procedure for PR use. **Conclusions:** This survey in a country with a relatively high patient-to-nurse ratio shows that PR is frequently used in patients receiving mechanical ventilation, with wide variations according to patient condition. The common absence of medical orders for starting or removing PR indicates that these decisions are mostly made by the nurses.

**Keywords** Intensive care unit · Mechanical ventilation · Sedation · Agitation · Restraint

## Introduction

In mechanically ventilated patients in the intensive care unit (ICU), physical restraint (PR) is traditionally used, either alone or in combination with sedative agents, to facilitate optimal patient care, mostly by preventing self-removal of devices needed to provide life-supporting treatments, such as the tracheal tube, central venous or arterial catheters, and drains.

However, PR has been reported to cause cutaneous, vascular, nervous and musculoskeletal injuries [1]. In addition, PR may worsen delirium and agitation [2, 3] and increase the risk of unplanned extubation [3–5]. Physical restraint is also a major source of patient discomfort during the ICU stay [6]. Finally, PR may jeopardize patient autonomy and dignity when it is perceived as degrading and may therefore constitute a source of psychological trauma [7]. In a large European multicentre observational study, one of the identified risk factors for post-traumatic stress disorder at 3 months was the use of PR with no sedation, raising the hypothesis that specific aspects of the everyday care of the critically ill patients may have important influence on subsequent long-term morbidity [8]. Physical restraint is considered acceptable in several countries including the USA whereas it is not in others, such as the UK [7] and Norway [9].

Despite the controversy about the potential benefits, side effects and ethical issues associated with PR, few data are available on the extent of and criteria for PR use in ICU patients receiving mechanical ventilation (MV). The current trend towards lighter sedation in ICU patients [10–14] may be expected to increase the exposure of awake patients to PR.

The purpose of this national survey was to specify the perceived use of PR and factors associated with PR use in patients undergoing invasive MV in French ICUs.

## Methods

The questionnaire was developed by three senior intensivists experienced in sedation of critically ill patients (see Electronic Supplementary Material). Most of the questionnaire items were closed-ended. The first section of the questionnaire summarized the ICU characteristics. The second section collected data about the frequency and duration of PR use, decision-makers for PR use, and patient factors associated with PR use. Most of the items in the second section were to be answered using a 4-point Likert scale [15, 16]. The questionnaire was discussed among a group of seven intensivists and revised until issues of relevance, clarity, ease of completion and educational value were solved. PR was defined as the use of mechanical wrist restraint, unless otherwise stated.

The anaesthesiology division of a French pharmaceutical company (GlaxoSmithKline, Marly-le-Roi, France) initially agreed to make all the company division's sales representatives available for the study during the month of May 2010. Each sales representative covers a geographical area with an average of six ICUs. The allocation of each area is made regardless of the representative's background. In May 2010, a company reorganization, including the anaesthesiology division, precluded the participation of all representatives in the study. The remaining representatives were not selected on the basis of the size and type of ICUs located in their geographical areas. Each ICU in any of the remaining representative geographical area was visited, representing 130 ICUs among the 340 ICUs in the French CEGEDIM (CEntre de GEstion, de Documentation, d'Informatique et de Marketing) healthcare database. At each ICU (regardless of the number of ICUs per hospital), the representative personally handed the questionnaire to the first intensivist met during the month of May 2010 then collected the filled in questionnaire 2 weeks later. The intensivist who filled in the questionnaire was asked to provide data on overall PR practices in the ICU, and discussion with one or more senior nurses was encouraged. The staff received no compensation for their participation in the survey.

### Statistical analysis

The data are described as number and percentage or as median and interquartile range (IQR). Intensive care units showing high versus low rates of PR use were compared using the Fisher exact test for categorical variables and the Kruskal–Wallis test for continuous variables. Values of *P* lower than 0.05 were considered significant. Statistical analyses were performed using SAS<sup>®</sup> (version 9.2, SAS Institute, Cary, NC, USA).

## Results

The questionnaire was returned by 121 (93 %) of the 130 ICUs. Table 1 reports the main characteristics of the responding ICUs, 66 % of which were mixed medico-surgical ICUs, with a median (IQR) number of annual admissions of 473 (360–724). The median patient-to-nurse ratio was 2.8 (2.5–3.0). A written sedation protocol is used in 51 % of responding ICUs (Table 1).

In 82 % of ICUs, PR is used at least once during MV in more than 50 % of patients (Fig. 1). PR is used in less than 25 % of patients receiving MV in only 6 % of ICUs. In 65 % of ICUs, PR, when used, is applied for more than 50 % of MV duration (Fig. 2).

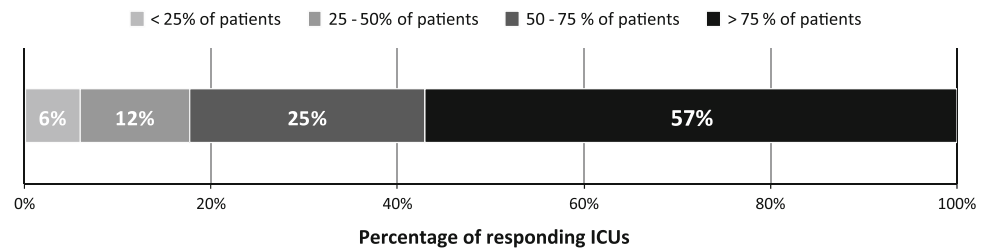
**Table 1** Characteristics of the 121 responding intensive care units

|  |                |
|--|----------------|
| Type of hospital   |                |
| Public university hospital, <i>n</i> (%)                     | 46 (38)        |
| Public non-university hospital, <i>n</i> (%)                 | 57 (47)        |
| Private hospital, <i>n</i> (%)                               | 8 (7)          |
| Other, <i>n</i> (%)  | 10 (8)         |
| Type of ICU  |                |
| Medical-surgical ICU, <i>n</i> (%)                           | 80 (66)        |
| Medical ICU, <i>n</i> (%)                                    | 15 (12)        |
| Surgical ICU, <i>n</i> (%)                                   | 24 (20)        |
| Other, <i>n</i> (%)  | 2 (2)          |
| ICU activity during the last full year (2009) prior to study |                |
| ICU beds, median (IQR)                                       | 12 (10–16)     |
| Admissions, median (IQR)                                     | 473 (360–724)  |
| Proportion of patients requiring MV, median (IQR)            | 70 % (60–79 %) |
| SAPS II score, median (IQR)                                  | 41 (37–45)     |
| Proportion of surgical patients, median (IQR)                | 30 % (20–60 %) |
| ICU staff  |                |
| Full-time physicians, median (IQR)                           | 5 (4–6)        |
| Patient-to-nurse ratio, median (IQR)                         | 2.8 (2.5–3.0)  |
| Sedation practices   |                |
| Use of a sedation score, <i>n</i> (%)                        | 88 (72)        |
| Use of a written sedation protocol, <i>n</i> (%)             | 62 (51)        |
| Daily interruption of sedation, <i>n</i> (%)                 | 19 (16)        |

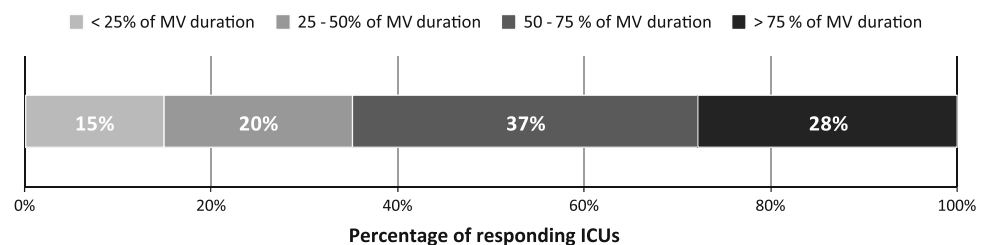
ICU intensive care unit, IQR interquartile range

Figure 3 reports the use of PR according to clinical condition. Physical restraint is often used in patients awakening from sedation or showing agitation, and less often in patients deeply sedated, undergoing neuromuscular blockade or suffering severe tetraparesis. In 29 % of ICUs, PR is used in more than 50 % of awake, calm and co-operative patients. Physical restraint tightness is adapted according to the patient's condition in 81 % of ICUs.

**Fig. 1** Frequency of physical restraint. We asked responding ICUs about the frequency of their use of physical restraint in patients receiving mechanical ventilation. *ICU* intensive care unit



**Fig. 2** Duration of physical restraint. We asked responding ICUs about the average percentage of mechanical ventilation during which physical restraint is used. *MV* mechanical ventilation, *ICU* intensive care unit



Physical restraint is started without a written medical order in more than 50 % of patients in 68 % of ICUs, and removed without a written medical order in more than 50 % of patients in 77 % of ICUs (Fig. 4). Only 21 % of ICUs have written local procedures for PR use.

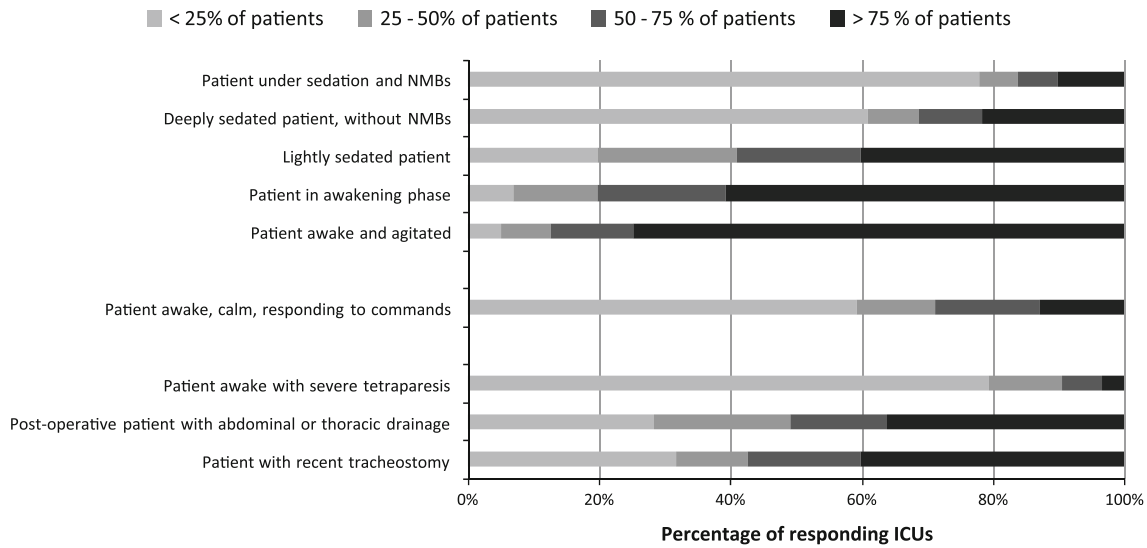
In 56 % of ICUs, the reason for currently using PR is explained (whoever provides the explanation, i.e. either the nurse, the attending physician, the resident or another staff member) to the relatives of more than 75 % of patients (Fig. 5). The reason for currently using PR is explained to more than 75 % of the patients after awakening in 42 % of ICUs.

When we compared ICUs using PR in less than 75 % of patients (52 [43 %] ICUs) to those using it in more than 75 % of patients (69 [57 %] ICUs), we found no significant differences in terms of proportion of university hospitals, proportion of surgical patients, patient-to-nurse ratio or use of written sedation protocols (Table 2).

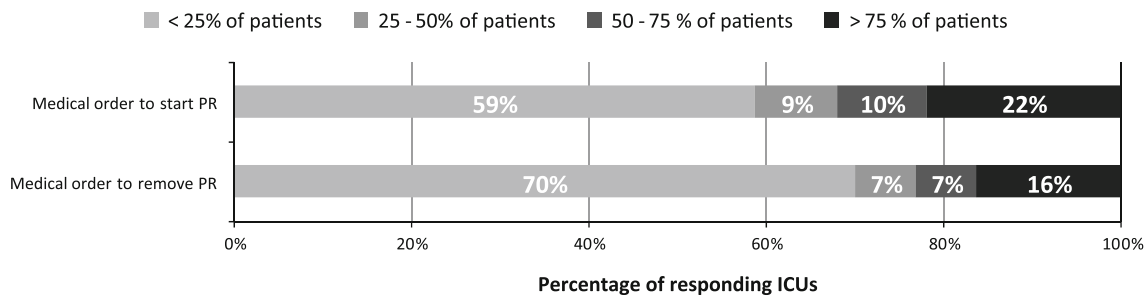
Among the participating ICUs, 80 % had the feeling that discontinuing PR use in mechanically ventilated patients would not be achievable.

## Discussion

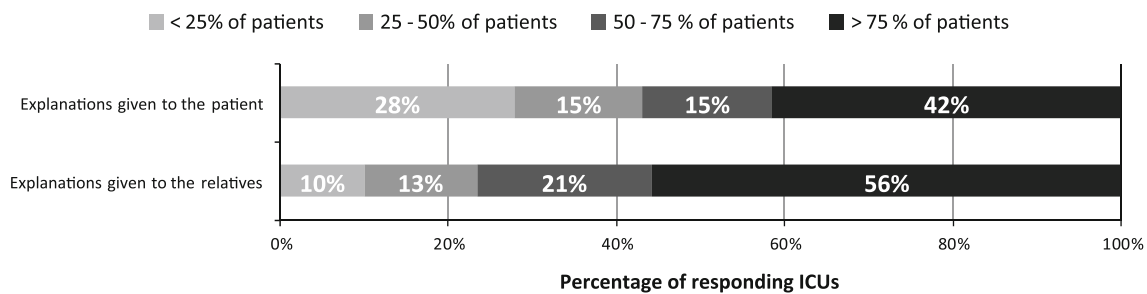
This nationwide survey showed a high rate of PR use in mechanically ventilated patients in French ICUs. Only a minority (6 %) of ICUs use PR in less than 25 % of patients undergoing MV. Furthermore, in 65 % of ICUs, PR is used during more than 50 % of the time spent under MV. These results suggest that PR use constitutes an essential component of the management of mechanically ventilated patients in French ICUs. In keeping in line with this possibility, more than three-quarters of the ICUs considered that discontinuing PR use would not be



**Fig. 3** Use of physical restraint according to clinical conditions. We asked responding ICUs about the frequency of physical restraint use in patients receiving invasive mechanical ventilation according to various clinical conditions. *NMB* neuromuscular blockers, *ICU* intensive care unit



**Fig. 4** Written order for physical restraint use. We asked responding ICUs about the percentage of patients, when physical restraint is used, with a written medical order to start (*top*) or remove (*bottom*) physical restraint. *PR* physical restraint *ICU* intensive care unit



**Fig. 5** Explanation given to the patient and relatives about the use of physical restraint. We asked responding ICUs about the percentage of patients, when physical restraint is used, with use of physical restraint explained to the patient at awakening (*top*) and the relatives (*bottom*). *ICU* intensive care unit

achievable. To our knowledge, this is the first nationwide survey of PR use in critical care patients. We chose to focus on the use of PR in the mechanically ventilated patients as these patients share, among various risks, the potentially life-threatening risk of removing the tracheal

tube, and therefore are a rather specific group of patients in terms of PR use.

The high rate of PR use in our survey contrasts with data from several other countries. In the European one-day point-prevalence Physical Restraint use in Intensive

**Table 2** Comparison of intensive care units with physical restraint used in less and in more than 75 % of the patients

|   | ICUs with PR used in <75 % of the patients, <i>n</i> = 52 ICUs | ICUs with PR used in ≥75 % of the patients, <i>n</i> = 69 ICUs | <i>P</i> value |
|---|--|--|----------------|
| University hospital, <i>n</i> (%)                           | 20 (39.2)  | 26 (38.2)  | 0.8            |
| Patient-to-nurse ratio, median (IQR)                        | 2.5 (2.5–2.7)  | 2.5 (2.5–3.0)  | 0.5            |
| Percentage of surgical patients in the ICU, median (IQR)    | 25 (20–50)   | 30 (20–68)   | 0.2            |
| Use of a written sedation protocol in the ICU, <i>n</i> (%) | 28 (54.9)  | 34 (50.7)  | 0.7            |

PR physical restraint, IQR interquartile range, ICU intensive care unit

Care units across Europe (PRICE) study PR was not used in any of the two ICUs in Portugal or in the four ICUs in the UK but was used in all the patients in the single ICU in Italy and in 40–50 % of patients in Switzerland (5 ICUs), Spain (2 ICUs) and France (12 ICUs) [17]. Likewise, none of the 50 patients in two Danish ICUs received PR, the latter being used to the contrary in 40 % of 50 patients in three American ICUs [9]. Ethical considerations mainly contribute to explain the extremely low rate of PR use in some countries, such as the UK [7]. Differences in patient-to-nurse ratios and in targeting sedation level may also contribute to the country-to-country variability [9, 17]. In our study, we found no significant association between PR use and the patient-to-nurse ratio. This can probably be attributed to the limited variability in the high patient-to-nurse ratio across participating ICUs (>2.5 in 75 % of the ICUs).

Another important finding from our survey is that PR is usually started and removed without written medical orders or clearly established local policies and that nevertheless PR use varies widely depending on patient condition. This suggests that PR is often started and removed on the basis of the nurses' initiative and practical judgment, that the use of PR is considered by ICU physicians a minor decision that does not play an integral part in the medical management and that there is a need to bring into focus amongst ICU physicians the advantages, drawbacks and ethical implications of PR use.

Our patients fall roughly into three groups based on PR use and clinical condition.

Physical restraint is infrequent in patients with a low risk of agitation and inadvertent device removal, namely those with deep consciousness impairment, neuromuscular blockade or severe tetraparesis. On the other hand, PR is very often used in agitated patients, even if, conversely, agitation can also be prolonged by the use of PR [2]. It is also often used in awakening patients, as long as the risk of agitation remains unclear. The third category is awake, calm and co-operative patients. In our study, nearly 30 % of ICUs use PR in more than 50 % of these patients. The risk of unplanned device removal in these patients should be carefully weighed up against the potential adverse effects of causing patient discomfort and perceived loss of dignity along with post-traumatic stress disorder. Among

experiences recalled by ICU patients, physical restraint is one of those considered to be the most unpleasant, at a level similar to the feeling of being choked by the endotracheal tube or not getting enough air from the endotracheal tube [6]. The current strong trend towards lightening sedation in critically ill patients is likely to increase the time spent by ICU patients in this category. Alternatives to physical and chemical restraints in awake, calm and co-operative patients could include transient increase in nurse-to-patient ratio or extended presence of family and relatives, both to confirm the low risk of device removal and to prevent device removal in case of removal attempt.

The absence of medical orders for PR use can put nurses in a difficult position, for example when a patient removes a catheter or tube after the attending nurse has interrupted PR on the basis of observations suggesting a low risk of agitation. Consequently, nurses may be reluctant to remove PR in calm and co-operative patients. The development of local policies for PR use including detailed descriptions of conditions requiring PR use could shift the burden of responsibility from nurses to the entire ICU team staff and therefore result in a decrease in PR use. A Canadian ICU staff survey found that an educational intervention with a decision tool (Restraint Decision Wheel), although first appearing as a challenge, finally resulted in a reduction in use of PR [18, 19]. Nurses commented that using the decision tool aided in relieving the pressure arising from the initiative of removing or not starting PR. In our survey, only one-fifth of the responding ICUs have a written local procedure for PR use.

We sought to achieve a high rate of response to minimize selection bias, often leading to a falsely optimistic picture of the real situation. Our study questionnaire was handed to and collected from the investigators in person by a representative of a drug company (that was neither fully nor partially involved in PR use in ICU). As a consequence, our response rate was high (93 %). However, drug representatives were not available to include all 360 ICUs in the French CEGEDIM ICU database. Nevertheless, the participating ICUs covered a broad range of ICU characteristics (university and non-university hospitals; medical, surgical and mixed ICUs; ICU size; and annual ICU

admission rate). Further evidence that our ICU sample was representative of the current situation in France comes from the close similarity between ICU characteristics in our study and in a 2007 questionnaire survey conducted by the same group, in which all CEGEDIM database ICUs were invited to participate and 61 % returned filled in questionnaires [20].

Another limitation of questionnaire surveys is that differences may exist between reported and actual practices, mainly because perception is inherently subjective. Discrepancies in the perception of PR use might exist between physicians and nurses. As several questions, including the two main questions of the survey (i.e. in how many patients is PR used at least once during MV, and what percentage of MV duration is spent with PR), required a longitudinal rather than transversal view of the patient stay in ICU, it was decided that the respondents should be the physicians rather than nurses. Furthermore, as we anticipated that starting and removing PR would depend mostly on the nurse's—not physician's—initiative, the physician's questionnaire response represented a more neutral perception of the overall ICU practices. Physicians, however, were encouraged to discuss with the ICU nurses to answer the questionnaire, although the consultation with the nurses was not formalized and the

number of nurses finally involved in the discussion was not recorded. Self-reporting bias could also have weakened the comparison between ICUs using PR in less and more than 75 % of patients. For the above reasons, information about the actual practices would also be useful and will be obtained in a future prospective observational study. It is also uncertain whether similar results in terms of frequency of PR use and clinical conditions associated with its use could be reproduced in a country with a lower patient-to-nurse ratio.

In conclusion, the information from this survey may be useful in countries with high baseline rates of PR use, such as France. Physical restraint use could be improved by increasing awareness among ICU physicians of the advantages and drawbacks of PR, requiring written medical orders to start and remove PR, and identifying factors associated with the greatest benefits from PR. The variations in PR use according to patient condition shown in the present survey could serve as a reasonable basis for developing and implementing PR use policies on a local or national scale.

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