


ORIGINAL



# Pain distress: the negative emotion associated with procedures in ICU patients

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## Abstract

**Purpose:** The intensity of procedural pain in intensive care unit (ICU) patients is well documented. However, little is known about procedural pain distress, the psychological response to pain.

**Methods:** Post hoc analysis of a multicenter, multinational study of procedural pain. Pain distress was measured before and during procedures (0–10 numeric rating scale). Factors that influenced procedural pain distress were identified by multivariable analyses using a hierarchical model with ICU and country as random effects.

**Results:** A total of 4812 procedures were recorded (3851 patients, 192 ICUs, 28 countries). Pain distress scores were highest for endotracheal suctioning (ETS) and tracheal suctioning, chest tube removal (CTR), and wound drain removal (median [IQRs] = 4 [1.6, 1.7]). Significant relative risks (RR) for a higher degree of pain distress included certain procedures: turning (RR = 1.18), ETS (RR = 1.45), tracheal suctioning (RR = 1.38), CTR (RR = 1.39), wound drain removal (RR = 1.56), and arterial line insertion (RR = 1.41); certain pain behaviors (RR = 1.19–1.28); pre-procedural pain intensity (RR = 1.15); and use of opioids (RR = 1.15–1.22). Patient-related variables that significantly increased the odds of patients having higher procedural pain distress than pain intensity were pre-procedural pain intensity (odds ratio [OR] = 1.05); pre-hospital anxiety (OR = 1.76); receiving pethidine/meperidine (OR = 4.11); or receiving haloperidol (OR = 1.77) prior to the procedure.

**Conclusions:** Procedural pain has both sensory and emotional dimensions. We found that, although procedural pain intensity (the sensory dimension) and distress (the emotional dimension) may closely covary, there are certain factors than can preferentially influence each of the dimensions. Clinicians are encouraged to appreciate the multidimensionality of pain when they perform procedures and use this knowledge to minimize the patient's pain experience.

**Keywords:** ICU, Procedures, Pain distress

## Introduction

Evidence developed over the past 25 years has been overwhelming that pain is a frequent occurrence for patients in intensive care units (ICUs) [1–3]. Research endeavors have done well to concentrate on the intensity of pain,

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which is the degree of the pain sensation. As a result, we know that pain intensity is substantial and varies according to the type of injury [4], illness [5], or medical procedure [6]. Pain intensity, related to the degree of severity of the sensation, is but one of pain's multiple dimensions. A second dimension is the affective nature of pain, or the degree of distress experienced by a patient. Pain distress is related to emotional unpleasantness and concern about threat to life or well-being [7]. In fact, a recently proposed change to the definition of pain reinforces pain as a distressing experience, which recognizes its aversive nature [8].

In non-ICU [9, 10] and ICU [11] symptom research, considerable attention has been given to the differences in patient reports of pain intensity and distress; however, ICU pain research has fallen short of addressing the psychological dimension of pain, pain distress, even though unrelieved pain is one of the main sources of psychological stress for ICU patients [12, 13].

While measures of pain intensity and pain distress are often highly correlated [14], this correlation is not 100% [15]. Pain science has clearly delineated the differences between the two. Neural mechanisms of both the sensory/intensity and affective/distress dimensions of pain have been well mapped, and brain structures that are differentially involved in pain intensity and pain distress have been identified [16, 17]. (Of note, a patient with a postcentral stroke lost pain sensation while pain affect was preserved [18].) Clinically, different types of pain have been associated with greater pain distress (e.g., cancer-related pain) or greater pain intensity (e.g., labor pain) when intensity and distress measures are compared [7]. Affective responses (i.e., distress) can be influenced by contextual factors; for example, pain associated with cancer can make a person more fearful of a poor prognosis than pain associated with labor. It has been long understood that these two dimensions of pain can covary under some conditions and not under others [19]. An empiric understanding of the distress that accompanies commonly performed procedures in ICUs can provide support for the measurement of both dimensions in clinical settings [7] and could guide selection of interventions.

The work presented here is a pre-planned sub-study from the Europain<sup>®</sup> project, with the original study previously published [20]. This was a multinational sample of ICU patients who underwent selective diagnostic or treatment-related procedures in which we concentrated on pain intensity associated with procedures. Since, in that study, we asked patients to not only report pain intensity but to also report pain distress associated with their procedure, we are able to analyze this dimension of pain in a large ICU patient population. Our purpose here

is to answer the following research questions related to procedural pain distress:

1. Does pain distress increase when ICU patients undergo frequently performed procedures and, if so, is the increase significant?
2. Are there certain factors that cause ICU patients to experience a greater degree of pain distress when they undergo procedures?
3. Are there certain factors that cause ICU patients to have greater pain distress than pain intensity when they undergo procedures?

## Methods

### Design, site, and sample

Europain<sup>®</sup> was a prospective, cross-sectional, multicenter, multinational study of procedural pain associated with 12 procedures commonly performed in ICUs. Europain<sup>®</sup> received support from the European Society of Intensive Care Medicine (ESICM). Each of the 28 participating countries had volunteer National Coordinators (NC). One or more physicians or nurses working in the 92 study ICUs volunteered to be ICU Study Coordinators. While this study was extensively described previously [20], we repeat certain information related to study subjects and procedures to offer sufficient background to evaluate this current analysis.

Patients were eligible if they were 18 years of age or older, able to speak English or their country's primary language, and were to undergo at least one of the study procedures as part of standard care. Exclusion criteria were clinical instability, treatment with neuromuscular blockers, conditions associated with altered pain perception (e.g., Guillain-Barré disease), conditions likely to interfere with behavioral assessments of pain (e.g., decerebrate posturing), and/or a definitive or probable diagnosis of delirium by the ICU clinician. Patients with delirium were excluded because the validity of their reports could not be assured as a result of non-use of validated delirium scales in many of the ICUs.

Ethics committee approval was obtained at the study coordinating center in Paris and at the home institution of the principal investigator (KP). IRB approval which met local legislation criteria, including whether or not patient consent was required, was mandatory for study participation in all ICUs. Failure to obtain this approval ( $n=9$  countries) or withdrawal after IRB approval ( $n=2$  countries) left 28 of an original 39 participating countries.

### Measures

Pain distress was measured using a horizontal 0–10 numeric rating scale (NRS), with higher numbers indicating greater distress. NRS scales have both construct [21,

22] and concurrent validity [21, 23], and pain distress has been measured in non-ICU [24] and ICU studies [25, 26]. Prior to the procedure, patients were asked the following question: “How distressful (or bothersome) is your pain *right now*, where 0=no distress and 10=very distressing?” Immediately after the procedure, patients were asked, “How distressful (or bothersome) was your pain *during* the procedure, where 0=no distress and 10=very distressing?” Pain intensity was also measured using a 0–10 NRS, with higher numbers indicating greater pain intensity. Prior to the procedure, patients were asked, “What number would you give the *worst* pain you have had today, where 0=no pain and 10=worst possible pain?” Prior to the procedure, they were also asked the following question: “How intense is your pain *right now*, where 0=no pain and 10=worst possible pain?” Immediately after the procedure, patients were asked, “How intense was your pain *during* the procedure, on this scale where 0=no pain and 10=worst possible pain?” Patients who were unable to report pain intensity/distress scores were eliminated from analyses requiring these scores. Pain behaviors were also recorded before and during the procedure, and the psychometric properties of the behavioral observation form have been published [27].

### Procedures

A full description of study procedures can be found in our previous article [20]. In short, ICU coordinators selected the procedure(s) to be studied in their ICUs from a predefined list (see Electronic Supplement Table 1 for procedures and definitions), and patients could be enrolled for one or two procedures if not performed at the same time. There were two ICU clinician data collectors for each procedure; each recorded patient responses to the questions posed to the patient by one of them, as well as observing and recording pain behavior data [27], for data reliability analyses. Pain distress and intensity were assessed prior to and immediately after the procedure, with the latter being measures of procedural pain. ICU coordinators sent all completed data collection packets to the study center in Paris for data entry. For analyses in this report, we used data from patients who were able to report pain distress and intensity prior to and immediately after the procedure. Country religiosity was assessed using data from the Gallup Poll results released in 2009 (the question asked was “Is religion important in your daily life?” and religiosity was the percentage of “yes” answers per country (<http://news.gallup.com/poll/13117/religion-europe-trust-filling-pews.aspx>)). Countries with religiosity greater than 81% who participated in the study include Romania, Brazil, India, and Tunisia.

### Statistical analyses

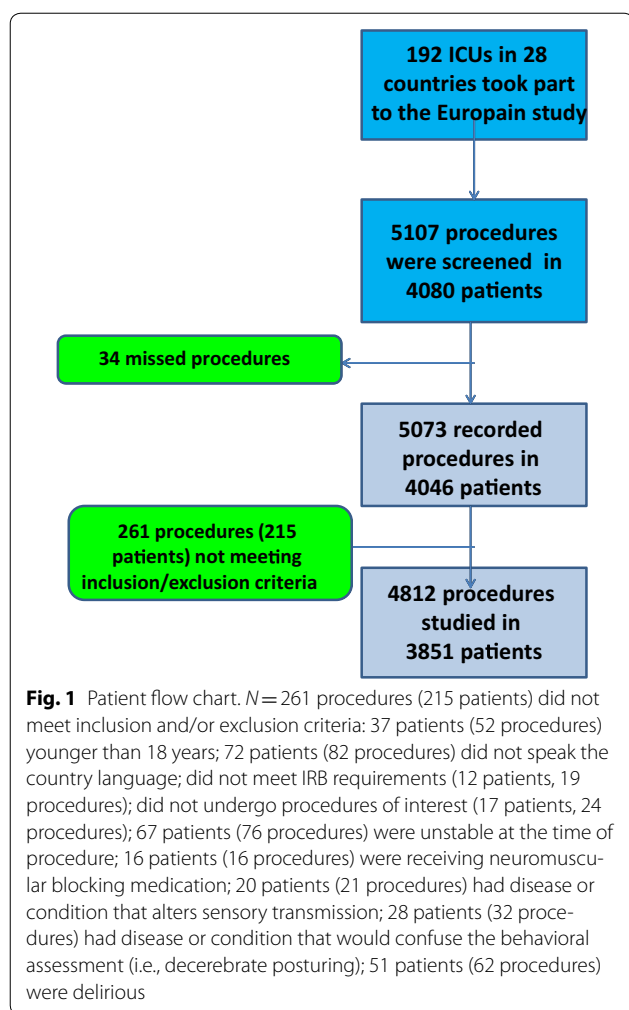
A Bland–Altman analysis was conducted to determine the levels of agreement between pain intensity and pain distress. Other results are expressed as numbers (%) for categorical variables and medians [interquartile range, IQR] for continuous variables, unless stated otherwise. The primary outcome measure for this report was procedural pain distress, which was studied using negative binomial regression in a hierarchical model with ICU and country as random effects. Multivariate models adjusting for potential confounding factors were built. Variables associated with  $P$  values less than 0.20 by univariate analysis were entered into the multivariate model and kept if the  $P$  value was less than 0.05. Adjusted relative risks and 95% confidence intervals (95% CI) were calculated for each parameter estimate.  $P$  values less than 0.05 were considered significant. Analyses were computed using the SAS 9.3 software package (SAS Institute, Cary, NC, USA).

Although there were two simultaneous data collectors, in order to test reliability of the data collected, a single observation data point per procedure was used to avoid creating an additional level in the final hierarchical model. For NRS values, this observation was the mean of the values recorded by the two data collectors. For binary variables, when data from one observer were missing, the data from the other observer were used. Concordance between the two observers for pain scores was excellent ( $\kappa > 0.90$ ).

### Results

A total of 192 ICUs in 28 countries participated in the study. Of the 5107 procedures in 4080 ICU patients observed for the study, 4812 procedures (94%) in 3851 patients were evaluable (Fig. 1). Data on patient characteristics have been previously published [20]. Briefly, 61% of patients were male; the median age was 62 [50–73]; 37.2% of patients were mechanically ventilated during the procedure; and 65% patients were able to speak or otherwise communicate. The median admission SOFA score was 3.7 [2–6.1], and median procedure day RASS score was 0 [–1 to 0]. ICU mortality rate was 10.3%.

The most common procedure was turning ( $n=873$ ), and the least common was wound drain removal ( $n=75$ ). Median/[IQR] procedural pain distress scores on the 0–10 NRS were highest for endotracheal (ET) (4 [1–7]) and tracheal (4 [2–6]) suctioning, chest tube removal (4 [2–6.5]), and wound drain removal (4 [1–7]) (Table 1). Pain distress scores increased significantly from before the procedure (from a median of 0 [0–4] to 3 [0–5] depending on procedure) to during the procedure (from 2 [0–5] to 4 [1–7],  $P < 0.00$  depending on the procedure)



( $P<0.001-0.005$ ) for all procedures except for wound care.

The Bland–Altman analysis shown in Fig. 2 demonstrates that, while there was a high degree of agreement between pain intensity and pain distress, there was variability between the two measures. In fact, Pearson’s correlation between the two was 0.79. This finding reinforces that, while pain intensity and pain distress can be highly correlated [14, 15], the correlation was not 100%. Subsequent analyses identified where differences existed in patients, i.e., where pain intensity and pain distress were different for the patient.

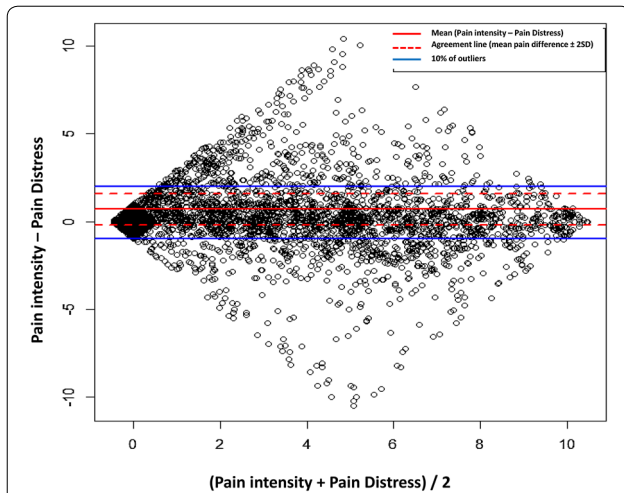
Several risk factors independently predicted that patients would have a higher degree of procedural pain distress (Table 2). These included certain procedures: turning [relative risk/confidence interval=1.18/1.02–1.37], ETS (1.45/1.14–1.66), tracheal suctioning (1.38/1.14–1.66), CTR (1.39/1.16–1.66), wound drain removal (1.56/1.23–1.99), and arterial line insertion (1.41/1.15–1.73). Certain pain behaviors exhibited by the patient prior to the procedure predicted that the patient’s pain distress would be higher during the procedure: grimacing (RR/CI=1.19/1.09–1.31), eyes closed (RR/CI=1.11/1.02–1.20), and moaning (RR/CI=1.28/1.12–1.48). The higher the patient’s “worst pain intensity” score on the procedure day was also a significant risk for them having higher procedural pain distress (RR/CI=1.15/1.13–1.16).

Finally, if patients had received morphine (RR/CI=1.12/1.02–1.23) or tramadol (1.17/1.05–1.30) or other opioids on the procedure day (RR/CI=1.22/1.06–1.40), prior to the procedure, or if they received opioids specifically for the procedure (RR/CI=1.15/1.02–1.28)

**Table 1** Differences in pain distress before and during procedures

Procedures	Frequency	Pre-procedural pain distress (median [Q1–Q3])	Pain distress during procedure (median [Q1–Q3])	Median difference [Q1–Q3]	<i>P</i> value *
Turning	873	2 [0–5]	3 [0–6]	0 [0–2]	<0.001
Endotracheal suctioning	767	2 [0–5]	4 [1–7]	1 [0–3]	<0.001
Mobilization	526	1 [0–4]	2 [0–5]	0 [0–2]	<0.001
Respiratory exercises	439	2 [0–4]	3 [1–6]	0 [0–2]	<0.001
Positioning	371	1 [0–5]	2 [0–5]	0 [0–2]	<0.001
Peripheral blood draw	328	0 [0–4]	2 [0–5]	0 [0–2]	<0.001
Peripheral IV insertion	315	1 [0–4]	2 [0–5]	0 [0–2]	<0.001
Tracheal suctioning	302	2 [0–5]	4 [2–6]	1 [0–4]	<0.001
Wound care	301	3 [0–5]	3 [0–6]	0 [0–1.5]	0.063
Chest tube removal	292	2 [0–5]	4 [2–6.5]	1 [0–3]	<0.001
Arterial line insertion	199	1 [0–4]	3 [1–6]	1.5 [0–4]	<0.001
Wound drain removal	75	2 [0.5–5]	4 [1–7]	1 [0–4]	0.005
Others	24	3 [0–5]	3 [0.5–5]	1 [0–2]	0.060

\* Wilcoxon test



**Fig. 2** Bland–Altman graph showing the correlation between scores for procedural pain intensity and pain distress (both reported on a 0–10 NRS scale) as being strong but not perfect. To increase readability, a random value of  $\pm 0.5$  was added

they were more likely to be at risk for higher procedural pain distress. The country did not have a significant effect on pain distress; however, there was a significant ICU effect.

For our third analysis, we conducted multivariate modeling to identify factors that would put patients at risk for experiencing greater pain distress than pain intensity. (Pain intensity scores are reported in Table 2 of our previous publication [20], and pain distress scores are found here in Table 1.) With tracheal suctioning as the comparator, the odds were that most of the procedures would be associated with *less* pain distress than intensity (Table 3). Conversely, for chest tube removal, wound drain removal, and mobilization, degrees of pain intensity and pain distress were similar. However, the odds of patients having *greater* pain distress than intensity during the procedure were if the patient's pre-procedural pain intensity score were significantly higher [odds ratio (OR)/CI 1.05/1.01–1.09] or if patients had pre-hospital anxiety (OR/CI 1.76/1.29–2.41).

Finally, if patients received pethidine/meperidine (RR/CI 4.12/1.05–16.07) or haloperidol (RR/CI 1.77/1.01–3.12) before the procedure, the odds for patients experiencing *greater* pain distress than intensity were higher.

## Discussion

To our knowledge, this is the first extensive report on ICU patients' experiences of pain distress and the only

**Table 2** Factors that predicted significantly greater pain distress during the procedure, as identified by multivariable analysis

	RR	CI 95%	P value	Overall P value
<b>Procedures</b>				<0.0001
Turning	1.18	(1.02–1.37)	0.02	
Chest tube removal	1.39	(1.16–1.66)	<0.001	
Wound drain removal	1.56	(1.23–1.99)	<0.001	
Wound care	1.11	(0.93–1.31)	0.24	
Others	1.17	(0.70–1.95)	0.54	
Positioning	1.03	(0.87–1.22)	0.70	
Mobilization	1.04	(0.90–1.21)	0.58	
Respiratory exercises	1.11	(0.95–1.30)	0.17	
Peripheral IV insertion	1.05	(0.89–1.24)	0.59	
Arterial line insertion	1.41	(1.15–1.73)	<0.001	
Endotracheal suctioning	1.45	(1.24–1.70)	<0.001	
Tracheal suctioning	1.38	(1.14–1.66)	0.001	
<b>Behaviors</b>				
Grimace before the procedure	1.19	(1.09–1.31)	0.0002	0.0002
Eyes closed before the procedure	1.11	(1.02–1.20)	0.0123	0.0123
Moaning before the procedure	1.28	(1.12–1.48)	0.0005	0.0005
Worst pain intensity day of but prior to procedure	1.15	(1.13–1.16)	<0.001	<0.001
Morphine administered on study day	1.12	(1.02–1.23)	0.02	0.02
Tramadol administered on study day	1.17	(1.05–1.30)	0.01	0.01
Other opioids administered on study	1.22	(1.06–1.40)	0.01	0.01
Opioids specifically administered for the procedure	1.15	(1.02–1.28)	0.02	0.02

Hierarchical mixed model with random effect of country and ICU showing that there was no country effect, but there was an ICU effect

**Table 3 Factors that predicted greater pain distress than pain intensity during the procedure: a multivariate model**

	Odds ratio	95% CI		P value*	Overall P value*
		Upper limit	Lower limit		
Number of beds in ICU	0.979	0.965	0.994	0.0050	0.0050
Religion class 2	0.670	0.503	0.893	0.0063	0.0063
Anxiety prior to hospital admission	1.761	1.289	2.407	0.0007	0.0007
Procedure					0.0002
Turning	0.626	0.398	0.986	0.0432	
Chest tube removal	0.625	0.361	1.081	0.0927	
Wound drain removal	0.822	0.394	1.715	0.6022	
Wound care	0.477	0.274	0.829	0.0087	
Others	0.635	0.168	2.406	0.5043	
Positioning	0.422	0.248	0.717	0.0014	
Mobilization	0.652	0.407	1.046	0.0761	
Respiratory exercises	0.570	0.347	0.937	0.0265	
Peripheral IV blood draw	0.382	0.222	0.658	0.0005	
Peripheral IV insertion	0.269	0.148	0.490	<0.0001	
Arterial line insertion	0.305	0.149	0.625	0.0012	
Endotracheal suctioning	0.817	0.506	1.319	0.4082	
Tracheal suctioning <sup>a</sup>	1.000				
Behaviors: neutral expression prior to procedure	0.767	0.605	0.973	0.0292	0.0292
Pain intensity prior to the procedure	1.048	1.009	1.089	0.0166	0.0166
Pethidine/meperidine prior to the procedure	4.116	1.054	16.067	0.0418	0.0418
Haloperidol prior to the procedure	1.771	1.006	3.120	0.0477	0.0477

CI confidence interval

\*Hierarchical model with effect of ICU center

<sup>a</sup> Tracheal suctioning was the reference

ICU study to investigate this pain distress using a model of procedural pain. We found that patient-reported pain distress increased significantly from the pre-procedure time to the time of the procedure for all procedures except for wound care. While not surprising, this has not been documented previously. We also found that half of the procedures increased the risk of patients having higher degrees of pain distress by at least 30%: ET and tracheal suctioning, chest tube removal, wound drain removal, turning, and arterial line insertion. There may be some factors unique to these procedures that may account for the higher distress. The first two procedures, ET and tracheal suctioning, can not only cause pain but also a decrease of oxygenation levels, choking, gagging, and shortness of breath. Chest tube removal also affects the pulmonary system, as the tube is moved from the interpleural space through pulmonary and chest wall tissues. These actions, which many patients have described as fearful [25], may be seen as an intrinsic emotional threat due to the interference with breathing. It is unclear why drain removal is associated with a risk of higher pain distress, but the movement of drains through body

parts may feel like a threat to a person's tissue integrity. Another risk for higher procedural pain distress was when patients had reported a higher degree of "worst pain intensity" on the day of, but previous to, the procedure. It may be that their pain during the day had been more bothersome to them because they had "hurt more", causing them more distress when they were subjected to additional, procedural pain. This distress may have been reflected in certain behaviors exhibited prior to the procedure (eyes closed, grimacing, and moaning), also risk factors for higher procedural pain distress. Taken together, these findings of higher pain levels the day of, but prior to, the procedure and behaviors of distress that they were exhibiting could increase a clinician's "index of suspicion" that the pain that patients were about to experience during the procedure could cause them increased distress. Attending to the distress of patients undergoing procedures may be as important to the patient as attending to the intensity of the experience. Clinicians could consider using analgesics to decrease the procedural pain intensity and non-pharmacological interventions such as

providing information [24] and soothing talk or music [26] to decrease the procedural distress.

When patients were receiving opioids on the day of the procedure or received opioids specifically for the procedure, they, too, were at risk for higher degree of procedural pain distress. It is perplexing why opioids received before a procedure would be a risk factor for increased procedural pain distress. The reasons for these patients receiving opioids are unknown. Perhaps, they received opioids for the procedure but the drug had not reached peak effect at procedure time. Perhaps the amount of opioid administered was insufficient to relieve the pain, leading to increased procedural pain distress. It is also possible that patients who had been receiving opioids during their ICU stay were experiencing opioid-induced hyperalgesia (OIH), a state of enhanced pain sensitivity [28]. OIH may occur when there is an increase in perceived pain with an increase in opioid use and has been identified in postoperative patient populations [29]. Investigating the reason(s) for our finding is beyond the scope of our study. Yet, this finding was similar to that found in our previous report [20], in that patients who received opioids prior to the procedure reported greater procedural pain intensity. Future research is warranted to discern the intriguing relationship among opioid administration for a procedure and pre-procedural and procedural pain intensity and distress. In the meantime, as we are currently concerned about potential short- and long-term adverse effects from use of opioids, a multimodal approach to procedural pain management through use of non-opioid analgesics alone or concurrent with use of (lower) opioid doses may be considered [30].

Some of the significant risk factors for higher procedural pain distress (i.e., certain procedures, receiving opioids, and a higher degree of “worst” pain intensity prior to the procedure) were treatment-related not intrinsically patient-related. Thus, these factors may be under the control of clinicians who can influence the procedural pain experience of patients, either positively or negatively. As noted by others [7], the emotional dimension of pain does not depend solely on how much tissue is damaged or how intense the pain is; it is greatly influenced by the psychological context in which pain occurs.

In another analysis, we asked: “Are there certain factors that cause ICU patients to have greater pain distress than pain intensity when they undergo procedures?” We found that for half of the procedures, the risk for patients was to experience higher pain intensity than pain distress. Yet for chest tube removal, wound drain removal, and mobilization, the differences between procedural pain intensity and distress were not significant. These findings accentuate the fact that pain is multidimensional and what is done to a patient can be both intense (invasive)

and distressful (emotionally unpleasant) and, in a certain situation, one can predominate [7]. What is essential is that both are assessed by clinicians in order to individualize treatment approaches in a particular situation.

We also found that patients with higher pre-procedural pain intensity were at risk for having greater procedural pain distress than pain intensity during the procedure. It may be that patients with a high degree of pain intensity prior to the procedure experienced the procedure as a “threat to life or well-being” [7], causing them greater distress. Indeed, there is evidence for a unilateral direction of causation: pain sensation causes pain unpleasantness, not vice versa [16], an experience that we may have seen in our study. Thus, lowering the patient’s pain intensity before a procedure begins could make the procedure less distressful.

Those who had pre-existing anxiety also had greater procedural distress than intensity. Anxiety has long been known to be an important psychological correlate of pain and plays an important role in pain affect/distress [15].

Regarding medications, surprisingly, if patients received pethidine/meperidine prior to the procedure, they reported significantly greater pain distress than intensity during the procedure. This is a counterintuitive finding, as discussed earlier. As noted earlier, we found that when patients received opioids before the procedure, they reported greater pain distress during the procedure.

As noted in our previous report on pain intensity [20], our study had limitations: convenience enrollment, a low acuity ICU sample, considerable variability of sample sizes across the represented countries, and lack of randomization of patients, ICUs, or countries. Our exclusion of patients with delirium, while increasing internal validity, decreases external validity because of the high proportion of ICU patients with delirium [31]. The validity of pain reports from patients with delirium is a very important area for future research focus. Strengths of this study were its prospective design and rigorous standardization of data collection procedures, and it was the largest multinational study of ICU procedural pain conducted. Furthermore, we were able to include patients who were mechanically ventilated which allowed them to be represented in our findings about procedural pain. Indeed, our 37% sample of ventilated patients is actually representative of the percentage of ICU patients, in general, who receive invasive ventilation (approximately 33%) [32]. We found, for the first time, that pain distress, a salient dimension of a person’s pain experience, during procedures is prevalent and that certain procedures cause the greatest distress: ET and tracheal aspiration, chest tube, and wound drain removal, turning, and arterial line insertion. Thus, asking patients to rate their pain distress as well as pain intensity is warranted. Future

research is needed that examines interventions to relieve both the intensity and the distress caused by procedural pain. Perhaps a more important first step is to ensure that clinicians understand that assessing pain, including its severity and distress, is the essential first step in managing pain, procedural or otherwise. Many clinicians, including those in ICU, are not receiving adequate pain assessment education [33–35], including the important component of pain distress. Clinician recognition of pain distress, as a companion to pain intensity, could serve ICU patients well and negate at least part of the stress of being a patient in an ICU.

## Conclusion

In measuring the negative emotional experience of pain during ICU procedures, we found that patients reported more pain distress during procedures than before the procedures. In addition, there are certain factors that increase pain distress and sometimes make distress greater than pain intensity. Although pain intensity and distress may closely covary [7], as we found, there are certain factors than can powerfully and preferentially influence each of the dimensions. Clearly, procedural pain is both a sensory and emotional phenomenon affected by many clinical conditions. While it is impossible to avoid procedures in ICU, it may be possible to decrease the level of associated distress [36] through such simple intervention as providing information to the patient about the procedure they are to undergo [24]. Clinicians are encouraged to appreciate the multidimensionality of pain when they assess their patients' pain and perform procedures, and to use this knowledge to minimize the pain experiences of their patients.

## Electronic supplementary material

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KAP, EA, AM, study concept and design. KAP, AM, EA, training materials. KAP, EA, JFT, SR, data analysis and interpretation. KAP, EA, JFT, SR, manuscript preparation and drafting. KAP, EA, JFT, SR, statistical methods, statistical data analysis. AM, GC, GR, JM, FRC, JVD, MS, DCI, IMG, SMM, KR, RO, IE, EDEP, MK, GMJ, GB, RCF, KMH, AK, RTG, JK, MMSS, MN, DDB, MSGS, AH, FJP, JSB, FA, AA, JRCM, YA, acquisition of the data and manuscript critique and review. All authors approved the manuscript submitted.

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#### Compliance with ethical standards

#### Conflicts of interest

The authors declare that they have no conflicts of interest.

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