Prospective Study

# The Role of Pain Catastrophizing in the Provision of Rescue Analgesia by Health Care Providers Following Major Joint Arthroplasty

Patricia Pinto, PhD[1,2], Teresa McIntyre, PhD[3], Vera Araujo-Soares, PhD[4], Ramon Ferrero, MD[5], and Armando Almeida, PhD[1,2]

From: [1]Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho, Braga, Portugal; [2]ICVS / 3B's – PT Government Associate Laboratory, Braga / Guimarães, Portugal; [3]Texas Institute for Measurement, Evaluation and Statistics (TIMES) and Department of Psychology, University of Houston, USA; [4]Institute of Health and Society, Faculty of Medical Sciences, Newcastle University, UK ; [5] Alto Ave Hospital Center, Orthopedics Unit, Guimarães, Portugal

Address Correspondence:
Patrícia R. Pinto, PhD
Life and Health Sciences Research Institute (ICVS)
School of Health Sciences
Campus de Gualtar
University of Minho
4710-057 Braga
Portugal
E-mail:
patipinto@ecsaude.uminho.pt

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**Background:** After surgery, patient reports or health care professional evaluations of heightened acute pain intensity should lead to extra analgesia provision, which is designated by rescue analgesia (RA). Whether RA is administered or not, it is not directly dependent on the patient but rather on clinical decisions, which should be based on pain management guidelines. There is a general lack of studies focusing on pain-related decision-making regarding RA provision.

**Objectives:** This study aimed to examine which pre and post-surgical factors, beyond acute post-surgical pain intensity, might influence clinical decisions on RA administration after major joint arthroplasties (MJA).

**Methods:** A consecutive sample of 110 patients undergoing MJA was fully assessed 24 hours before (T1) and 48 hours after (T2) surgery. Before surgery, baseline demographic, clinical, and psychological variables were evaluated and after surgery the main outcome was RA provision, with acute post-surgical pain intensity being also registered.

**Study Design:** Prospective observational cohort study.

**Setting:** Central hospital in northern Portugal.

**Results:** Logistic regression analysis revealed that RA provision, after MJA, is influenced by a patient-related psychological factor, pain catastrophizing (OR = 1.143; 95% CI 1.044 – 1.253, $P$ = 0.004), above and beyond acute post-surgical pain intensity. Additionally, the type of arthroplasty (OR = 2.806; 95% CI 1.002 – 7.857, $P$ = 0.050) also affected RA provision. Other patient-related factors such as gender, previous pain states, pre-surgical optimism, and post-surgical anxiety did not reveal any predictive role in RA administration.

**Limitations:** This is a single-site study, only confined to MJA patients.

**Conclusions:** The findings of this study shed light on the importance of psychological factors in determining RA provision following MJA. This encourages further reflection on acute post-surgical pain management by health care providers, namely by raising clinicians' awareness about the factors that influence patient-provider interactions, as well as their impact on decision-making regarding RA provision. A global assessment of patients, wherein psychological variables are taken into account, is warranted in order to improve the quality of surgical pain management. Finally, these findings provide support for the design of acute post-surgical pain management interventions directed at clinicians, in order to augment professionals' awareness about the potential influence of patient-related psychological factors on RA decisions.

**Key words:** Rescue analgesia, major joint arthroplasty, post-surgical pain intensity, psychological factors, pre-surgical pain catastrophizing, patient-provider interactions, pain-related decision-making, predictive analysis

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After surgery, an adequate and efficient control of acute pain is essential for surgical recovery (1), preventing potential negative consequences associated with the inadequate management of acute pain (2). To deal with this, Acute Pain Services prescribe standardized analgesic protocols aimed at appropriately controlling post-surgical pain (3). These protocols are tailored to type of surgery, to associated expected pain severity, and to patients' health status (2,4).

Nonetheless, each patient reveals distinct analgesic needs and reports different levels of pain even when submitted to the same surgery type and analgesic protocol (5,6). Consequently, patients' reports and/or health care professionals' evaluations of heightened acute pain intensity should lead to extra analgesia provision, which is designated by rescue analgesia (RA). Whether RA is administered or not does not depend solely on patients' reported pain intensity, but rather is based more broadly on multiple factors that influence physicians' clinical decisions (2,4,7).

Previous studies have identified age, surgery type, and psychological distress as predictive risk factors for higher analgesic consumption after surgery (8). However, these studies did not focus specifically on RA, but rather on analgesic consumption in general. Actually, there is a general lack of studies focusing on pain-related decision-making regarding RA provision. One exception is Pinto and colleagues (9) work, who found that other factors, beyond acute pain intensity, influenced clinical decisions of RA administration. In that study other clinical factors (e.g., anesthesia type) along with patient-related characteristics (e.g., pre-surgical fear and post-surgical anxiety) predicted RA after hysterectomy.

In other studies, albeit not focused on health professionals' decision-making, pre-surgical pain intensity related significantly with more analgesic consumption after hip arthroplasty (10) and after cesarean (11). Acute post-surgical pain intensity was also a predictor of RA (12) and an independent predictive factor of morphine requirement (13). Another study revealed that patient-controlled analgesia (PCA) lockout interval demands were based on pre-surgical psychosocial factors (intrusive thoughts and avoidant behaviors), regardless of pain intensity (14). Other authors investigated the role of pain catastrophizing on request of analgesia (15) or general analgesic use (16-18) albeit with conflicting results. In clinical pain-related decision-making, analgesic administration is influenced not only by patient post-surgical pain intensity, but also by patient demographic characteristics and by the way pain is expressed and communicated (9,19).

In this work we try to increase our understanding on the factors influencing the decision of RA provision. Are they strictly dependent on the analgesic protocol guidelines and thus on acute post-surgical pain intensity levels? Or, are they also dependent on patient-related factors that influence patient/health care provider decisions?

This study aimed to examine which pre- and post-surgical factors, beyond acute post-surgical pain intensity, might influence clinical decisions on RA administration after major joint arthroplasties (MJA). Understanding the variables that influence RA provision should support better acute post-surgical pain control in patients undergoing MJA. This type of surgery, either targeting the hip or the knee, is a high cost surgical procedure which does not always present successful outcomes (20,21). Moreover, orthopedic surgery of major joints is considered to be amongst the most painful operations (8,22). MJAs are also amongst the most commonly performed surgeries worldwide, due to the aging population and the subsequent rise in the prevalence of knee and hip osteoarthritis (23-26).

## Methods

### Patients and General Procedures

This study is part of an ongoing large prospective cohort study investigating acute and persistent post-surgical pain (PPSP) prevalence among MJA. Ethical approval was granted by the Hospital's Ethic Committee. Patient informed consent was obtained as a condition to participate in the study. Both assessments were performed at the hospital by a trained psychologist.

A consecutive sample of 110 patients undergoing MJA was fully assessed in all measures 24 hours prior (T1) and 48 hours after surgery (T2) and enrolled in current analyses. In the present work, the site of arthroplasty was either the knee (n = 52) or the hip (n = 58). Inclusion criteria were ages between 18 and 80 years and undergoing total knee (TKA) or hip (THA) arthroplasty following a diagnosis of coxarthrosis and gonarthrosis only (osteoarthrosis in the hips and the knees, respectively). Arthroplasties performed due to fractures were excluded, as well as hemiarthroplasties, revision, and emergency arthroplasties. The presence of psychiatric or neurologic pathology (e.g., psychosis, dementia) and an ASA status (physical status classification of the American Society of Anesthesiologists) above 3

were exclusion criteria.

All patients received usual routine post-surgical care and no research-related change was introduced in the standard clinical protocol. Health care professionals, namely orthopaedic and anesthesiology staff (physicians and nurses), were blind to the aims of this study during all the evaluation process.

## Pre-surgical Assessment –(T1) – 24 Hours before Surgery

A socio-demographic (e.g., age, gender) and clinical data questionnaire (e.g., body mass index, chronic back pain, other joint pain) was administrated to collect various demographic and clinical data. Pain intensity was measured on an 11 point (0 – 10) numeric rating scale (NRS) (27).

Concerning psychological variables, Hospital Anxiety and Depression Scale (HADS) (28) was used to measure anxiety and depression. Additionally, Life Orientation Test – revised (LOT-R) (29) was employed to evaluate the personality trait optimism. Surgical Fear Questionnaire (30) assessed specific surgical fears and the Pain Catastrophizing scale of the Coping Strategies Questionnaire – Revised Form (CSQ-R) (31) evaluated pain catastrophizing.

## Anesthetic Technique and Analgesic Protocols

The types of anesthesia used were: 1) loco-regional (n = 76/69.1%), which could be done using spinal anesthesia (SA) or epidural anesthesia (EA), and 2) loco-regional (SA or EA) plus peripheral nerve blocks (n = 34/30.9%). ASA status included cases of class I (7/6.4%), II (82/74.5%), and III (21/19.1%).

A standardized analgesia protocol was prescribed for all patients, following standard operational procedures and norms of analgesia care at the hospital. This protocol was established and supervised by the acute pain service and was assigned in the recovery room, before patients were transferred to the orthopedic infirmary.

Delivery of the analgesic protocol could be intravenous (n = 31; 28.2%), epidural (n = 50; 45.5%), or peri-neural (n = 29; 26.4%) for the 48 hours following the surgery, followed by oral analgesics on subsequent days.

The standardized intravenous protocol was delivered via a continuous intravenous infusion (DIB – delivered infusion balloon) and was composed of tramadol (300 – 600 milligram), metamizol (6 – 8 g), and metoclopramide (60 mg). The standardized epidural protocol was delivered via a continuous epidural infusion (DIB) composed by ropivacaine (0.1%) and fentanyl (3 μg/mL) (5 mL/h). Finally, the standardized peri-neural protocol was delivered via a continuous peri-neural infusion (DIB) with ropivacaine (0.2% – 5 mL/h). All these 3 protocols' doses were programmed to last for the first 48 hours after surgery (48 hour-doses). For the 3 types of protocols, paracetamol (1 g, every 6 hours) and non-steroidal anti-inflammatory drugs (NSAIDS – ketorolac 15 – 30 mg, every 12 hours or parecoxib 20 – 40 mg, every 12 hours) were always included as coadjuvant analgesics. All analgesic regimens also included prokinetic treatment that was standardized to metoclopramide (10 mg intravenous, every 8 hours). According to analgesic guidelines, all protocols had indications for the prescription of RA drugs beyond the standardized analgesic protocol, given moderate to severe acute post-surgical pain levels (NRS > 3), either reported by patients or assessed by health care professionals. The RA drugs depended on the prescribed protocol. For intravenous protocols, intravenous pethidine (15 – 20 mg) was provided. Local anaesthetic ropivacaine was the selected RA drug for both epidural [0.2% (5 mL)] and peri-neural protocols [0.2% (5 mL)].

## Acute Post-surgical Assessment – 48 Hours after Surgery

The primary outcome measure was rescue analgesic provision, which was registered in medical records. A yes was recorded if the records demonstrated that the patient had been provided with RA drugs in the first 48 hours after surgery while staying in the orthopedic infirmary.

To assess acute post-surgical pain, patients were asked to rate their average and their worst pain level within the first 48 hours after surgery, using the 11-point NRS.

In order to prevent postoperative nausea and vomiting (PONV), all patients were prophylactically medicated with dexamethasone (10 mg) during surgery. In cases of reported moderate or severe PONV, ondansetron (4 mg intravenous 8/8 hours) was provided. In cases of moderate and severe levels of pruritus, patients were administrated with hydroxyzine (25 mg intramuscular 8/8 hours).

Regarding psychological variables, post-surgical anxiety was measured with the HADS anxiety subscale. The use of psychotropic drugs (anxiolytics and anti-depressants) during the hospital stay was also recorded.

### Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS version 22.0).

The primary outcome variable in this study is RA provision, a dichotomous variable registered as "no" vs "yes." To compare these 2 groups, t-tests (for continuous variables; normal distribution was evaluated through Kolmogorov-Smirnov test and/or through skewness and kurtosis absolute values) and Chi-square tests ($\chi 2$, for nominal variables) were performed. Furthermore, effect sizes and confident intervals were calculated to determine the meaningfulness of the differences (practical significance). They were expressed as Hedge's g for continuous variables and Pearson's phi ($\phi$) coefficient for nominal variables, due to distinct sample sizes of the 2 surgical groups.

To find predictors for RA provision a logistic regression model was performed. The results of univariate analyses (effect size and respective confidence intervals) were used to guide the choice of predictors to insert in the logistic regression model. Pearson and Point-biserial correlation coefficients were calculated amongst the psychological variables in order to further explore the degree of association between them. To control for the influence of multicollinearity, the variance inflation factor value (VIF) was established as being below 2 and the tolerance coefficient was set to be greater than 0.60. To evaluate the role of the assumptions used, sensitivity and specificity analyses were performed to complement the logistic regression analyses. Besides, the model's capability to discriminate between patients with or without RA administration was estimated by the area under the receiver operating characteristics curve (ROC area) of the model.

Additional exploratory statistical analyses were performed to address possible confounding factors regarding the variability of the 3 different standard analgesia protocols and the distinct 2 types of RA drugs. Thus, a chi-square test and analyses of variance (One-way Anova) were performed to determine if there were any differences amongst the 3 analgesic protocols regarding both the administration of RA and the intensity of post-surgical pain, respectively.

## Results

### Comparison between RA Groups

From a total sample of 110 patients undergoing arthroplasty, 38 were provided with RA after surgery and 72 patients were not (Table 1). Specifically, and regarding the group that received RA, 22 (57.9%) patients were provided with one dose, 14 (36.8%) patients with 2 doses, and 2 patients (5.3%) with 3 doses. Concerning socio-demographic measures, those who were prescribed RA and those who were not only differed on gender, with women revealing a higher likelihood of being administered RA [$\chi 2(1, n = 110) = 8.284$; $P = 0.004$].

Regarding pre-surgical clinical indicators, no significant differences were found between the groups. On pre-surgical pain variables, patients who were given RA were more likely to present other previous pain states [$\chi 2(1, n = 110) = 7.934$; $P = 0.005$]. They also revealed a worst psychological profile (Table 1), particularly with higher levels of pain catastrophizing [$t(53.447) = -4.502$; $P < 0.001$] and lower levels of optimism [$t(53.629) = 3.539$; $P = 0.001$], with the groups differences on both constructs revealing the larger effects sizes (ES = 1.018 and 0.801, respectively) amongst the pre-surgical psychological variables.

Results of post-surgical variables are presented in Table 2. Patients undergoing TKA were administered more often with RA [$\chi 2(1, n = 110) = 7.986$; $P = 0.005$] in comparison with THA patients. The RA group was also given more psychotropic drugs [$\chi 2(1, n = 110) = 9.242$; $P = 0.002$]. Besides, RA patients revealed heightened levels of acute post-surgical pain [$t(98.964) = -5.033$; $P < 0.001$] and post-surgical anxiety [$t(59.589) = -3.709$; $P < 0.001$]. No association was found between RA provision and the occurrence of side effects (like PONV or pruritus) nor between RA administration and the type of RA drug, as evidenced by data in Table 2.

### Comparison amongst Standardized Analgesic Protocols

Results of the One way-Anova test showed that there were no differences between the 3 analgesic protocols both in terms of post-surgical pain intensity [$F(2,107) = 2.393$; $P = 0.096$] and in RA provision ($\chi 2(1, n = 110) = 3.291$, $P = 0.193$). Hence, the variability of the standard analgesic protocols did seem to influence neither post-surgical pain levels nor the probability of providing RA.

### Inter-correlations of Variables

With the exception of fear, RA was significantly correlated with all psychological variables, yet pre-surgical optimism, pre-surgical pain catastrophizing, and post-surgical anxiety were the ones with a highest correlation ($r = -0.36$, $P < 0.001$; $r = 0.44$, $P < 0.001$; $r =$

Table 1. *Descriptive statistics and group differences on pre-surgical demographic, clinical, and psychological variables for the 2 RA subgroups (no rescue analgesia vs. rescue analgesia).*

| Pre-surgical Characteristics | No Rescue Analgesia (n = 72) | Rescue Analgesia (n = 38) | t / $\chi$2 | P | ES | 95% CI |
|---|---|---|---|---|---|---|
| **Demographic** | | | | | | |
| Age (years) | 64.7 (8.29) | 65.3 (6.90) | -0.422 | 0.674 | 0.075 | [0.000 – 0.458] |
| Gender (female) | 41 (56.9%) | 32 (84.2%) | 8.284 | 0.004 | 0.274 | [0.071 – 0.411] |
| **Clinical - general indicators** | | | | | | |
| Disease onset (months) | 110.2 (103.3) | 118.5 (123.2) | -0.370 | 0.712 | 0.074 | [0.000 – 0.453] |
| BMI (Kg/m$^2$) | 28.9 (5.60) | 30.9 (5.31) | -1.756 | 0.082 | 0.360 | [0.000 – 0.235] |
| Previous surgeries (yes) | 58 (81.7%) | 35 (92.1%) | 2.144 | 0.143 | 0.140 | [-0.081 – 0.259] |
| Pre-opioid intake | 3 (4.2%) | 3 (7.9%) | 0.670 | 0.413 | 0.078 | [-0.103 – 0.259] |
| Psychotropic use[a] | 21 (29.2%) | 19 (50.0%) | 4.665 | 0.031 | 0.206 | [-0.001 – 0.403] |
| **Clinical - pre-surgical pain** | | | | | | |
| Intensity (worst level) | 6.77 (2.11) | 7.47 (1.96) | -1.704 | 0.091 | 0.576 | [0.000 – 0.729] |
| Other previous pain states (yes)[b] | 37 (51.4%) | 30 (78.9%) | 7.934 | 0.005 | 0.269 | [0.065 – 0.422] |
| Pain other joints (yes) | 22 (31.0%) | 18 (48.6%) | 3.254 | 0.071 | 0.174 | [-0.034 – 0.374] |
| Back Pain (yes) | 28 (39.4%) | 22 (59.5%) | 3.922 | 0.048 | 0.191 | [-0.017- 0 –.382] |
| **Psychological measures** | | | | | | |
| Anxiety[c] | 4.32 (3.44) | 6.97 (4.89) | -2.982 | 0.004 | 0.672 | [0.222- – 0.993] |
| Depressionc | 1.33 (2.02) | 2.89 (3.73) | -2.404 | 0.020 | 0.589 | [0.110 – 0.873] |
| Surgical Fear[d] | 10.2 (14.3) | 15.9 (16.6) | -1.857 | 0.066 | 0.373 | [0.000 – 0.760] |
| Pain Catastrophizing[e] | 8.71 (4.54) | 14.4 (7.09) | -4.502 | < 0.001 | 1.018 | [0.500 – 1.309] |
| Optimism[f] | 8.86 (2.40) | 6.50 (3.73) | 3.539 | 0.001 | 0.801 | [0.304 – 1.112] |
| Functionality[g] | 46.1 (14.9) | 50.7 (13.7) | -1.572 | 0.119 | 0.315 | [0.000 – 0.701] |

Note. Continuous variables are mean (standard desviation), categorical variables are n (%).
aConsumption / Intake of anxiolytics and anti-depressants; bOther previous pain states (either acute or chronic, not related to the cause of surgery, but nonetheless frequent); cHospital Anxiety and Depression Scale, with scores ranging from 0 to 21; higher scores indicate higher levels of either anxiety or depression; dSurgical Fear Questionnaire, with scores ranging from 0 to 80; higher scores indicating higher levels of fear; eCoping Strategies Questionnaire Revised, with scores ranging from 1 to 30; higher scores indicating higher levels of each coping strategy used, fLife Orientation Test, with scores ranging from 1 to 12; higher scores indicating higher levels of optimism, gSickness Impact Profile, with scores ranging from 0 to 100; higher scores indicating lower levels of functionality.

-0.36, $P < 0.001$; respectively) (Table 3). Besides RA was also significantly associated with post-surgical pain intensity (r = 0.40, $P < 0.001$). These results reinforced the choice of predictors for logistical regression informed by Table 1 and Table 2. Moreover Table 3 allowed for the analyses of potential problems of shared variance amongst the selected psychological predictors, revealing no problems at this level [e.g., r(pre-surgical catastrophizing and post-surgical anxiety) = 0.34; $P < 0.001$].

### Factors Associated with RA provision

Table 4 shows the results of the logistical regression regarding the predictors of RA provision. In the final model, "pain catastrophizing" (OR = 1.143; 95% CI 1.044 – 1.253, $P = 0.004$) emerged as a clear significant predictor of RA administration, with "type of arthroplasty" (OR = 2.806; 95% CI 1.002 – 7.857, $P = 0.050$) also showing a predictive role. The other variables did not reach significance in the final model. Besides, the area under the receiver operator characteristic (ROC) curve was 0.84 (95% CI: 0.76 – 0.93) and sensitivity and specificity values were 68.4% and 91.7%, respectively.

## Discussion

This study aimed to increase knowledge on the factors associated with RA provision in the acute post-surgical period in patients undergoing MJA. Very little was found in the literature on the issue of pain-related decision-making regarding RA provision. This is the first study seeking to explore RA administration after

Table 2. *Descriptive statistics and group differences on anesthetic, surgical and analgesic variables for the 2 RA subgroups (no rescue analgesia vs. rescue analgesia), 48 hours after hip or knee arthroplasty.*

| Post-surgical Characteristics | No Rescue Analgesia (n = 72) | Rescue Analgesia (n = 38) | t / $\chi$2 | P | ES | 95% CI |
|---|---|---|---|---|---|---|
| **Clinical - general indicators** | | | | | | |
| Arthroplasty type: knee | 27 (37.5%) | 25 (65.8%) | 7.986 | 0.005 | 0.269 | [0.064 – 0.449] |
| Anaesthesia: LR+PNB | 18 (25.0%) | 16 (42.1%) | 3.408 | 0.065 | 0.176 | [-0.030 – 0.378] |
| Analgesia: perineural | 15 (20.8%) | 14 (36.8%) | 3.284 | 0.070 | 0.173 | [-0.033 – 0.376] |
| Length of stay | 6.84 (2.55) | 6.92 (4.10) | -0.122 | 0.903 | 0.024 | [0.000 – 0.161] |
| Psychotropic use[a] | 22 (30.6%) | 23 (60.5%) | 9.242 | 0.002 | 0.290 | [0.083 – 0.476] |
| **Clinical - pain & analgesic indicators** | | | | | | |
| Worst level surgical pain[b] | 5.79 (2.51) | 7.87 (1.77) | -5.033 | < 0.001 | 0.904 | [0.600 – 1.420] |
| RA drug (Ropivacaine) | 50(69.4) | 29(76.3) | 0.580 | 0.446 | 0.73 | [-0.140 – 0.247] |
| Ondansetron SOS | 6 (8.3%) | 4 (10.5%) | 0.145 | 0.704 | 0.036 | [-0.137 – 0.247] |
| Hydroxizine SOS | 1 (1.4%) | 2 (5.3%) | 1.407 | 0.274 | 0.113 | [-0.077 – 0.224] |
| **HADS[c]** | | | | | | |
| Anxiety | 2.56 (2.85) | 5.16 (3.80) | -3.709 | < 0.001 | 0.805 | [0.354 – 1.144] |

Note: Continuous variables are medians (range), categorical variables are n (%).
aConsumption / Intake of anxiolytics and anti-depressants; bNRS: Numerical Rating Scale (0 – 10); c Anxiety subscale of Hospital Anxiety and Depression Scale, with scores ranging from 0 to 21; higher scores indicate higher levels of anxiety.

*Table 3. Pearson and point-biserial correlation coefficients among psychological variables, post-surgical pain and rescue analgesia (RA).*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. ANX T1 | - | .57*** | .60*** | -.43*** | .55*** | .57*** | .17 | .30** | .30** |
| 2. DEP T1 | | - | .41*** | -.54*** | .54*** | .38*** | .18 | .22* | .27** |
| 3. FEAR | | | - | -.39*** | .36*** | .50*** | .29** | .14 | .18 |
| 4. LOT | | | | - | -.44*** | -.43*** | -.34*** | -.29** | -.36*** |
| 5. Pain CAT | | | | | - | .34*** | .30** | .38*** | .44*** |
| 6. ANX T2 | | | | | | - | .41*** | .33*** | .36*** |
| 7. PS Pain | | | | | | | - | .24* | .40*** |
| 8. RA Dose | | | | | | | | - | - |
| 9. RA Prov | | | | | | | | | |

ANX T1 = Pre-surgical anxiety at T1 (HADS: Hospital Anxiety and Depression scale); DEP T1 = Pre-surgical depression at T1 (HADS: Hospital Anxiety and Depression scale); FEAR = Fear of surgery (Surgical Fear Questionnaire ); Pain CAT = Pain catastrophizing (CSQ-R: Coping Strategies Questionnaire – revised scale); ANX T2 = Post-surgical anxiety at T2 (HADS: Hospital Anxiety and Depression scale); PS Pain = Worst level of acute post-surgical pain intensity; RA Dose = number of Rescue Analgesia doses; RAProv = Rescue Analgesia provision

arthroplasty. Interestingly, results indicate that RA administration is influenced by a patient-related psychological factor, pain catastrophizing, above and beyond acute post-surgical pain intensity level. Additionally, the type of arthroplasty also affected RA provision.

The influence of type of arthroplasty (or arthroplasty site) in RA prediction was an expected result since knee arthroplasty has been associated with more pain in comparison with hip arthroplasty, even though scientific evidence has mainly been gathered for persistent or chronic post-surgical pain forms (23,25,26,32-34). This fact seems to influence health professionals' decisions to attribute RA more often to TKA patients, which might reflect a trend of professionals to empirically associate TKA with heightened acute pain experience. In the present work TKA patients reported higher

acute pain levels than THA patients [t(108) = -2.525; *P* = 0.013].

One unanticipated finding was that acute post-surgical pain intensity did not emerge as a significant indicator of RA provision. In a similar study (7), albeit in hysterectomy, acute post-surgical pain intensity revealed a paramount influence on professionals' decisions of administrating RA. Other studies confirmed that having more pain after surgery was associated with more RA (12-14), although focused on patients' requests and not properly on health professionals' decision-making. Contrarily, other studies did not find a significant relationship (15-17).

In the current study, pain catastrophizing, a patient-related psychological factor, was revealed to significantly influence RA provision. Catastrophizing is a dispositional variable, consisting in a maladaptive response to pain that activates exaggerated negative cognitive and emotional schemas in face of painful experiences (35,36). This result corroborates the findings of several studies on the association between pain catastrophizing and pain-related issues, namely those that evaluated the role of pain catastrophizing as a predictor of analgesic consumption (15-18). Strulov et al (2007) (15) reported that pre-surgical pain catastrophizing correlated with the patient's request for patient-controlled analgesia after caesarean section, yet just in the recovery room and not in the ward. However it was not further investigated or explored as a potential RA predictor in predictive models. Granot and Feber (2005) (16) and Pavlin et al (2005) (17) found that pre-surgical pain catastrophizing did not predict post-surgical analgesic use in general (although not specifically RA). However, the former study found initially that pain catastrophizing predicted analgesic consumption, although this significance ceased after controlling for post-surgical pain in multivariate analyses. This did not occur in the current study. Indeed, even after adjusting the regression model for post-surgical pain intensity, pain catastrophizing was still a significant predictor of RA.

In a similar hysterectomy study (7) pain catastrophizing was not a significant predictor of RA. Instead pre-surgical fear was the main pre-surgical psychological predictor, a variable that did not even distinguish RA groups in the current study. It is possible that the surgical fear questionnaire embraced more closely the concerns of women undergoing hysterectomy (e.g., fear of anaesthesia) than pain catastrophizing. Besides, it is plausible that different surgeries carry different threats and perceived advantages or disadvantages, both for patients and professionals, triggering specific psychological issues that might impact distinctly on professionals' pain-related decision-making. In a variety of surgeries (16-18,37-39), pain catastrophizing correlated with higher post-surgical pain intensity, a finding replicated in the current study. Pain catastrophizing involves magnification of the threat value of pain as well as feelings of helplessness and pessimism in the ability to deal with it (35,36). Therefore, pain catastrophizing might influence the way patients manifest their pain, verbally and non-verbally,

Table 4. *Hierarchical logistic regression results for pre-surgical, surgical, and post-surgical predictors of rescue analgesia provision following TKA and THA.*

| Variables | Wald | OR (95% CI) | P |
|---|---|---|---|
| **Block 1** | | | |
| Gender[1] | 7.638 | 4.033 (1.500 – 10.840) | 0.006 |
| **Block 2** | | | |
| Other previous pain states[2] | 3.391 | 2.488 (0. 943 – 6.566) | 0.066 |
| **Block 3** | | | |
| Post-surgical pain intensity[3] | 10.231 | 1.416 (1. 144 – 1.753) | 0.001 |
| **Block 4** | | | |
| Type of arthroplasty (TKA)[4] | 2.846 | 2.193 (0.881 – 5.462) | 0.092 |
| **Block 5** | | | |
| Pre-surgical optimism[a] | 1.351 | 0.899 (0.752 – 1.076) | 0.245 |
| Pre-surgical pain catastrophizing[b] | 8.718 | 1.145 (1.047 – 1.253) | 0.003 |
| **Block 6 (Final Model)** | | | |
| Gender[1] | 0.141 | 1.270 (0.366 – 4.410) | 0.707 |
| Other previous pain states[2] | 0.665 | 1.601 (0.517 – 4.960) | 0.415 |
| Post-surgical pain intensity[3] | 3.382 | 1.258 (0.985 – 1.607) | 0.066 |
| Type of arthroplasty (TKA)[4] | 3.857 | 2.806 (1.002 – 7.857) | 0.050 |
| Pre-surgical optimism[a] | 0.734 | 0.922 (0.765 – 1.111) | 0.392 |
| Pre-surgical pain catastrophizing[b] | 8.280 | 1.143 (1.044 – 1.253) | 0.004 |
| Post-surgical anxiety[c] | 1.961 | 1.117 (0.957 – 1.303) | 0.161 |

Note. The final model correctly predicted 83.6% of all patients; $\chi 2(7) = 43.511$; $P < 0.001$; Nagelkerke R2 = 0.451; OR = odds ratio; CI = confidence interval
1Dichotomous variable: 0 = Men; 1 = Women; 2Dichotomous variable: 0 = No; 1 = yes; 3Continuous variable, NRS - Numerical Rating Scale (0 – 10) from BPI-SF: Brief Pain Inventory-Short Form; 4Dichotomic variable: 0 = THA: Total Hip Arthroplasty; 1 = TKA: Total Knee Arthroplasty; aContinuous variable, LOT-R: Life Orientation Test - Revised; bContinuous variable, CSQ-R: Coping Strategies Questionnaire - Revised (Pain Catastrophizing subscale); cContinuous variable, HADS-A: Hospital Anxiety and Depression Scale - anxiety subscale.

and hence influence health care professionals regarding RA provision. The link between high levels of pain catastrophizing and increased behavioral expression of pain has been previously reported (19,35,36,40,41). This would have implications on professionals' assessments of patients' pain and could be a barrier for appropriate pain assessment, since clinicians could be misled by using patients' pain behavior as a clue to evaluate pain intensity. Specifically, as Sullivan et al (41,42) states, since high pain catastrophizers exhibit a trend to display more pain behaviors and to engage in more effective strategies to communicate their pain, they lead observers to infer a more intense pain experience. Actually, these pain behaviors might be a way through which high catastrophizers attract the attention of others and foster others' care (41,42), since observers usually infer pain ratings based on communicative pain behaviors (41-44).

The findings of this study, while preliminary, shed light on an important target for improving surgical outcomes – the processes involved in RA provision, encouraging further reflection on acute post-surgical pain management by health care providers. Patient-related psychological characteristics seem to influence not only the pain experience, but also the decision of health professionals to provide RA to patients undergoing MJA, above and beyond pain intensity.

Our results are in accordance with the theoretical basis of the biopsychosocial model of pain (45), by highlighting that psychological and social components of pain, beyond the biological component, influence not only each person's pain experience but also clinicians' inferences or judgments of patients' pain. Pain results from a dynamic interaction between the abovementioned components. In our study clinicians were not only influenced by the biological component of pain, but also by psychological factors such as pain catastrophizing, which in turn interplays with the social dimension of pain by influencing the way pain is communicated by patients and interpreted by clinicians.

Bonnet and Marrot (2005) (46) advocate for an optimization of pain control after surgery, namely through the improvement of analgesics' effectiveness. Nevertheless, and since acute pain is not the only issue affecting RA delivery, a more global assessment of surgical patients that goes beyond pain evaluation and control seems mandatory (47). The adoption of the biopsychosocial model by health care providers, and the practical use of their components and respective interactions, would certainly assist providers in a better assessment of each patient's unique pain experience (48). Actually one of the issues that emerges from these findings is the importance of establishing a collaborative process between patients and health care professionals. In this process pre- and post-surgical psychological variables should be considered, beyond pain assessment, to ensure appropriate pain decision-making and patient care. Recent guidelines (49) suggest that clinicians should get additional contextual information regarding patients' pain, including psychosocial issues. It has been argued that more progress is warranted in this optimization of surgical pain relief, which is a key factor of surgical outcomes and recovery (1). The administration or not of RA is likely to influence this process of pain control optimization and thus the factors associated with provision or not of RA should be further investigated and taken into account.

Finally, these findings provide support for the design of acute post-surgical pain management interventions directed at clinicians. In those, augmenting professionals' awareness about the potential influence of patient-related psychological factors on RA decisions seems crucial. To support this approach the American Society of Anesthesiologists (ASA) task force concluded that health care providers' education and training is associated with patients' decreased pain intensity (4).

These findings must be interpreted with caution because there are some limitations both in terms of internal and external validity of the study.

Firstly, the type of anesthetic procedure, analgesia and RA protocols were controlled in all analyses but not standardized, which could be a study bias. However, with this methodology, the performance of usual clinical procedures could be assured, thus allowing for professionals' blinding to the study and reflecting the ecological validity and authenticity of our data.

Secondly, and concerning a potential confounding bias, there is always a risk that an apparent association between a risk factor and an outcome is being mediated by an unknown confounder. However, the majority of all potential confounding variables have been controlled for in the study, with the exception of health care professionals' variables. Even though this constitutes an important issue for future research, its approach might jeopardize the ecological validity of studies like the present one.

Thirdly, we acknowledge a potential selection bias due to the fact that this is a single site and single country study, which limits generalization. The study population is also confined to MJA patients and therefore it

cannot be generalized to other types of surgeries.

Finally, it could be argued that after surgery pain catastrophizing should have been assessed to ascertain if its post-surgical levels were similar to the pre-surgical levels and if it keeps influencing clinical decisions regarding RA. However, pain catastrophizing has been described as a stable dispositional variable (35,36). Hence, it was not expected that in a period of 72 hours (24 hours pre-surgery to 48 hours post-surgery) pain catastrophizing levels would change.

## Conclusion

In conclusion, it stems from this study that raising clinicians' awareness about the factors that influence patient-provider interactions, as well as their impact on decision-making regarding RA provision, seems to be mandatory. A global assessment of patients, wherein psychological variables are taken into account, is warranted in order to improve the quality of surgical pain management. This knowledge should be included in doctors' and nurses' pain training curricula.

Overall the results of this study call for a collaborative model of pain management and patient care during the process of surgery, which could be assisted by the inclusion of Health Psychologists in Acute Pain Services and the adoption of a more evidence-based approach to patient pain care before and after surgery.

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