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Psychological characteristics and the effectiveness of patient-controlled analgesia

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Summary

We have evaluated the level of state and trait anxiety, neuroticism, extroversion and coping style as predictors of the effectiveness of patient-controlled analgesia (PCA) in 110 patients undergoing total abdominal hysterectomy. After operation patients were allocated to receive pain control with either PCA or im injections (IMI). Pain was assessed using the short form McGill pain questionnaire at 6, 18 and 24 h after operation, and by recording the amount of analgesic consumed in the first 24 h after surgery. Both state anxiety and coping style were significant predictors of postoperative pain, irrespective of the method of analgesia used. Patients using PCA experienced significantly better pain control than those receiving IMI. However, it was those with high levels of state anxiety who experienced the greatest reduction in pain with PCA. In addition to achieving better pain control, patients who received PCA used significantly less analgesia and were discharged earlier than patients who received IMI. (*Br. J. Anaesth.* 1995; **74**: 271–276)

Key words

Analgesia, patient-controlled. Psychological responses.

Patient-controlled analgesia (PCA) has been shown to be of great value in the control of postoperative pain [1, 2]. However, PCA equipment is costly and this inevitably places constraints on its availability. Maynard [3] has argued that when scarcity is accepted, attention should be focused on the principles that are used to choose which patients receive what care and when it should be given. An understanding of the categories of patients for whom PCA is most beneficial is vital in order to allocate the systems effectively. Apart from the scarcity of PCA resources, there is recent evidence [4, 5] which shows that some patients are unwilling to make use of this method of analgesia and this should be taken into account in the allocation of PCA.

A significant degree of postoperative pain is predictable from the degree of trauma. However, it is recognized widely that the translation of this physiological element into pain experience is dependent on many psychological factors. State and trait anxiety, neuroticism and coping style have been judged to be the most important [6–9]. This study was undertaken to establish if prior knowledge of the patient's level of anxiety, degree of neuroticism and coping style can be used to predict which patients undergoing hysterectomy benefit most from PCA.

Patients and methods

PSYCHOLOGICAL MEASURES

Anxiety in this context is defined as a complex reaction which can be divided into state anxiety, a transitory state which varies in intensity and fluctuates over time, and trait anxiety, a personality disposition which remains relatively stable over time. The state–trait anxiety theory holds that people with a high trait anxiety are more sensitive in situations which involve threat [9]. Both state and trait anxiety were measured by the Spielberger state–trait anxiety inventory [10]. High state anxiety scores indicate high levels of anxiety at the time of measurement, while high trait anxiety scores indicate an anxious personality disposition. Possible scores on both measures range from 20 to 80.

Neuroticism refers to a clearly defined personality trait [11], measured with Eysenck's personality questionnaire (EPQ). A typical neurotic scoring highly on the EPQ is an anxious, worrying individual, who is moody and frequently depressed [11] (range 0–23). EPQ also assesses the personality dimension introversion–extroversion (range 0–23). High scores denote a typical extrovert; introverts are low scorers.

Coping style refers to the strategies individuals adopt in threatening situations and is also an indirect measure of desire for control [9]. Generally, people prefer either control in situations of threat, and seek it in the form of further information (if they cannot exert direct control), or they avoid it by distracting themselves. Coping style was measured using Mil-

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ler's behavioural style scale [12]. A high coping style score indicates a strong preference for information control which in turn can determine preference for behavioural control (range 0–16).

STUDY DESIGN

Hospital Ethics Committee approval was obtained for the study. We studied 110 patients admitted for elective abdominal hysterectomy at Lewisham Hospital between 1988 and 1990. Mean age was 52.10 (range 31–74) yr and mean weight 67.7 (SD 10.07) kg. Oral consent was obtained from all patients before administration of psychological questionnaires and before evaluation of postoperative pain. They were not given details of how their postoperative pain would be treated. Two patients refused to participate in the study.

Shortly after admission each patient completed questionnaires to assess state and trait anxiety, neuroticism, extroversion and coping style. As it has been suggested that introversion–extroversion has the capacity to either potentiate or modify the role of neuroticism in generating anxiety [13] and subsequently influence pain, extroversion was measured in order to determine the extent to which these personality dimensions are independent.

Although four premedicants were used (temazepam, papaveretum, pethidine and lorazepam) the majority of patients received temazepam ($n = 90$). All patients received a conventional anaesthetic comprising propofol induction, vecuronium or atracurium for neuromuscular block, fentanyl or papaveretum, with nitrous oxide and enflurane for maintenance. Regional blocking agents were not used.

After operation, patients received pain control either via PCA ($n = 61$) or conventional nurse administered im injection (IMI) ($n = 49$). Patient numbers were unequal as all patients were taken from a more extensive study ($n = 184$) covering several different surgical procedures. In this larger study allocation of patients to PCA and IMI was on a strictly alternating basis to ensure availability of the PCA system (Graseby Medical, Watford, England). Papaveretum 2–4 mg was used with a lockout time of 10–15 min.

On recovery from anaesthesia, patients in the PCA group were shown the PCA system and a demonstration was given of how to use the demand button for pain control. Anaesthetists were free to choose the demand dose and lockout interval. Patients in the IMI group were told to inform the nursing staff when they felt pain and they received papaveretum 15–20 mg with a minimum dosing interval of 4 h.

PAIN ASSESSMENT PROCEDURE

Pain assessments were carried out using the short form McGill pain questionnaire (SFMPQ) [14] at 6, 18 and 24 h after operation. The main component of the SFMPQ consists of 15 descriptors (11 sensory, four affective) which are rated on an intensity scale of 0 = none, 1 = mild, 2 = moderate and 3 = severe. The major pain score is a total score derived from the sum of the intensity values of words chosen. Although the SFMPQ also yields two unidimensional pain indices, a present pain intensity and a visual analogue scale, this study used the combined sensory and affective total pain score as a pain index because it was considered important to measure the quality as well as the intensity of the postoperative pain experience. The scores presented are the average of the three assessments. The amount of analgesic used also provided an indirect measure of pain experienced.

The length of postoperative hospitalization was recorded. Although discharge criteria were not standardized, all patients received care on the same gynaecological ward and were discharged as soon as possible. All patients were debriefed and told about the two types of pain relief and our interest in their effectiveness, the amount of drugs consumed and the relationship between these factors and the psychological profiles.

STATISTICAL ANALYSIS

Main group differences were examined using t tests (independent subject design) and the predictive value of the psychological measures was analysed using Pearson's product moment correlations and multiple regressions. Factorial analyses of variance (ANOVA) were used to assess if particular patient personality or psychological styles of response contributed to the effectiveness of PCA. This analysis took account of pain experienced at the three postoperative pain assessments (6, 18 and 24 h).

Results

There were no significant differences between PCA ($n = 61$) and IMI ($n = 49$) patient groups in age, weight, state anxiety, trait anxiety, extroversion or neuroticism (table 1). For coping style, patients in the IMI group had significantly higher scores ($t = 3.26$; df 108; $P < 0.01$) than those using PCA. PCA was superior to IMI in terms of reduction of total pain scores (fig. 1), reduction in analgesic medication and length of hospitalization (table 2).

However, the main aim of the study was to determine which psychological measures would be the best predictors of maximum benefit from PCA. Pearson's product moment correlations revealed clear relationships between personality variables and postoperative pain experience (table 3). Significant

Table 1 Mean (SD) [range] neuroticism, extroversion, state anxiety, trait anxiety and coping style scores in the IMI and PCA groups. $^{**}P < 0.01$

Variable	IMI ($n = 49$)	PCA ($n = 61$)
Neuroticism	12.2 (5.4) [2–23]	12.2 (4.6) [2–21]
Extroversion	11.8 (4.5) [2–20]	11.7 (5.0) [3–21]
State anxiety	44.9 (12.8) [25–76]	43.9 (14.0) [20–75]
Trait anxiety	36.9 (9.8) [22–62]	36.4 (8.8) [20–58]
Coping style	6.6 (3.2) [1–13]	4.7 (2.9) [1–12]**

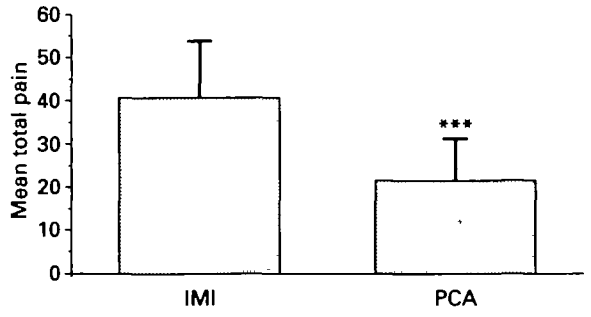

Figure 1 Comparison of mean total pain scores (sum of sensory and affective pain scores) for the IMI and PCA groups. ***$P < 0.001$.

Table 2 Mean (SD) total pain scores, total analgesic dose and length of hospitalization in the IMI and PCA groups. **$P < 0.001$, ***$P < 0.0001$

Variable	IMI ($n = 49$)	PCA ($n = 61$)
Total pain	40.7 (13.0)	21.6 (9.8)
Total analgesic dose (mg)	79.1 (19.8)	53.1 (19.8)***
Length of hospitalization (days)	7.9 (2.0)	6.8 (1.0)**

correlations were found between total pain score and state anxiety, trait anxiety, neuroticism and coping style in the combined data. Non-significant correlations were found for extroversion and total pain score. An additional pain measure was the total analgesic dose consumed and there were also significant correlations between this measure and both state anxiety and coping style ($r = 0.27, 0.23$).

When analysed separately, significant correlations were found between neuroticism, state and trait anxiety and total pain score for PCA. For IMI, neuroticism, and state and trait anxiety were correlated significantly with total pain score.

There was no correlation between neuroticism and extroversion. Multiple regression was used to determine the extent to which these psychological variables predicted postoperative pain (tables 4–6). State anxiety and coping style scores were most predictive of pain experience (as represented by total pain score) for PCA and IMI combined. The beta (or standardized regression) coefficient ascribed 39% of pain experience variance to state anxiety and 19% to coping style. However, when regressions were computed separately for PCA and IMI, state anxiety had a significantly greater impact on IMI. Examination of the beta weights revealed that state anxiety predicted 57% of pain experience for the IMI method compared with 46% for the PCA method. Multiple regression was calculated also for the other outcome measure, total dose of analgesic for the groups combined (regressions computed for the individual groups were not significant). State anxiety accounted for 23% of the variance in the total analgesic dose used and coping style accounted for 21% (table 7).

Table 3 Pearson's correlation coefficients of personality variables with pain measures for the PCA and IMI groups separately and combined

	Combined ($n = 110$)		IMI ($n = 49$)		PCA ($n = 61$)	
Variable	Total pain	Total analgesic dose	Total pain	Total analgesic dose	Total pain	Total analgesic dose
Neuroticism						
r, sig. of r	0.278, $p = 0.003$	0.178, $p = 0.062$	0.445, $p = 0.001$	0.231, $p = 0.110$	0.264, $p = 0.040$	0.196, $p = 0.13$
Limits of r	0.096–0.475	−0.010–0.369	0.189–0.767	−0.054–0.524	0.013–0.528	−0.059–0.456
Extroversion						
r, sig. of r	−0.073, $p = 0.448$	−0.016, $p = 0.867$	−0.100, $p = 0.496$	−0.074, $p = 0.616$	−0.113, $p = 0.385$	0.007, $p = 0.956$
Limits of r	−0.263–0.116	−0.206–0.173	−0.389–0.189	−0.362–0.215	−0.372–0.143	−0.250–0.264
State anxiety						
r, sig. of r	0.385, $p = 0.000$	0.275, $p = 0.004$	0.601, $p = 0.000$	0.389, $p = 0.006$	0.363, $p = 0.004$	0.244, $p = 0.058$
Limits of r	0.216–0.595	0.093–0.472	0.406–0.984	0.122–0.700	0.123–0.638	−0.008–0.506
Trait anxiety						
r, sig. of r	0.252, $p = 0.008$	0.178, $p = 0.063$	0.343, $p = 0.016$	0.275, $p = 0.056$	0.277, $p = 0.031$	0.130, $p = 0.317$
Limits of r	0.068–0.447	−0.010–0.369	0.069–0.646	−0.007–0.571	0.027–0.542	−0.127–0.388
Coping style						
r, sig. of r	0.226, $p = 0.017$	0.229, $p = 0.016$	0.106, $p = 0.468$	0.145, $p = 0.322$	−0.026, $p = 0.840$	0.024, $p = 0.856$
Limits of r	0.040–0.419	0.044–0.145	−0.183–0.395	−0.143–0.435	0.283–0.231	−0.233–0.281

Table 4 Summary of multiple regression analysis to predict total pain experience for PCA and IMI groups combined

PCA and IMI ($n = 110$)	Multiple r	r^2	Adj. r^2	SE	Significance of F
	0.461	0.213	0.181	13.2	0.0001
	Variables in the equation				
Variable	B	SE B	Beta	T	Sig. T
Neuroticism	0.246	0.316	0.083	0.777	0.438
State anxiety	0.431	0.117	0.386	3.68	0.0004
Trait anxiety	−0.103	0.183	−0.063	−0.57	0.572
Coping style	0.886	0.416	0.190	2.13	0.035

Table 5 Summary of multiple regression analysis to predict total pain experience for the IMI group

IMI ($n = 49$)	Multiple r	r^2	Adj. r^2	SE	Significance of F
	0.676	0.457	0.405	9.61	0.0001
	Variables in the equation				
Variable	B	SE B	Beta	T	Sig. T
Neuroticism	0.530	0.304	0.203	1.74	0.088
State anxiety	0.558	0.123	0.573	4.53	0.001
Trait anxiety	−0.012	0.178	−0.008	−0.060	0.947
Coping style	0.012	0.482	0.003	0.025	0.980

Table 6 Summary of multiple regression analysis to predict total pain experience for the PCA group

PCA ($n = 61$)	Multiple r	r^2	Adj. r^2	SE	Significance of F
	0.413	0.171	0.109	9.18	0 035
	Variables in the equation				
Variable	B	SE B	Beta	T	Sig. T
Neuroticism	−0.095	0.376	−0.045	0.034	0.802
State anxiety	0.332	0.116	0.457	2.86	0.006
Trait anxiety	0.058	0.196	0.053	0.297	0.768
Coping style	−0.368	−0.439	−0.109	−0.84	0.405

Table 7 Summary of multiple regression analysis to predict total analgesic dose required for PCA and IMI groups combined

PCA and IMI ($n = 110$)	Multiple r	r^2	Adj. r^2	SE	Significance of F
	0.594	0.353	0.125	22.8	0.001
	Variables in the equation				
Variable	B	SE B	Beta	T	Sig. T
Neuroticism	0.303	0.547	0.063	0.555	0.580
State anxiety	0.411	0.202	0.225	2.03	0.050
Trait anxiety	−0.012	0.316	−0.005	−0.390	0.979
Coping style	1.62	0.720	0.211	2.25	0.026

Table 8 Mean personality variables used for low and high categories ($n = 110$)

Variable	Mean (SD)	Min. – Max.
Neuroticism	12.2 (5.0)	2–23
State anxiety	44.3 (13.4)	20–76
Trait anxiety	36.6 (9.2)	20–62
Coping style	5.6 (3.1)	1–13

Finally, a factorial ANOVA for mixed-plot designs was used to ascertain if there were any significant interactive effects between any of the personality variables and methods of analgesia. In order to allow personality variables to be used as between-subject factors, pain scores for each assessment interval were analysed according to high and low personality profiles. High and low personality scores were defined as those above and below the mean (table 8). Table 9 shows mean total pain scores for high and low personality profiles for the three postoperative assessment periods combined. Thus the ANOVA used five between-subject factors (method, state anxiety, trait anxiety, coping style and neuroticism, each having two levels) and one within-subject factor, which was pain measured over three assessment intervals. Extroversion was not included in this assessment as it failed to influence pain in either direction.

Table 9 Mean (SD) (n) total pain scores for low and high personality categories in the IMI and PCA groups

	IMI ($n = 49$)		PCA ($n = 61$)	
Variable	Low	High	Low	High
Neuroticism	36.0 (11.7) (24)	45.2 (12.8) (25)	19.2 (8.0) (31)	24.1 (11.0) (30)
State anxiety	34.8 (10.2) (28)	48.7 (12.2) (21)	19 0 (8.2) (32)	24.6 (10.7) (29)
Trait anxiety	38.1 (12.3) (28)	44.2 (13.4) (21)	19.1 (8.3) (34)	24.7 (10.8) (27)
Coping style	39.5 (13.6) (21)	41.6 (12 7) (28)	21.4 (9.0) (22)	22.1 (11.4) (39)

Analysis of these results revealed that method of analgesia, state anxiety and neuroticism had significant effects on postoperative pain experience ($F_{(1,75)} = 94.03$, $P < 0.0001$; $F_{(1,75)} = 15.99$, $P < 0.0001$; $F_{(1,75)} = 4.50$, $P < 0.05$, respectively). Of particular interest was the significant interaction between levels of state anxiety and method of analgesia ($F_{(1,75)} = 5.76$, $P < 0.025$).

Discussion

The present study confirmed earlier reports of the superiority of PCA over IMI both in controlling postoperative pain [1, 2] and in reducing length of hospitalization [1, 15]. Previous studies [16] have reported that not all patients who use PCA obtain adequate pain relief and the explanations have been attributed to factors such as small demand dose or short action of analgesic. Explanations in terms of psychological factors are equally pertinent. However, with notable exceptions [4], PCA is frequently assumed to work in a relatively consistent fashion for everyone.

In the present investigation coping style was a significant predictor of pain experience for the analgesic methods combined, but not when the groups were assessed separately. This suggests that the IMI group was not disadvantaged significantly by the chance finding of higher levels of coping style among patients using this method. Therefore, our intuitive feeling that patients with high preference for control (high coping style) would benefit most from PCA is not borne out by the present findings. However, the general impression gained from a questionnaire evaluation of PCA [17] (which included the present sample of patients) was a high degree of patient satisfaction with this method of analgesia. In addition, control was highlighted as one of the most liked features. It is therefore possible that pain scores may not mirror levels of satisfaction exactly. Support for this suggestion comes from Wheatley and colleagues [1], who found significantly higher satisfaction scores for PCA than for extradural analgesia, even though the latter produced better pain scores. Further studies are therefore required to assess the patients' desire for control and the effect that this might have on effective use of PCA.

Neuroticism also had a significant influence on pain and is consistent with recent findings of Thorp and colleagues [18]. However, although these authors found a relationship between neuroticism and extroversion, no such correlations were achieved in the present study. This apparent independence of neuroticism and extroversion is in keeping with the hypothesis that these dimensions are quite separate and are subserved by distinct neurophysiological entities [19].

Patients with high levels of preoperative state anxiety are particularly vulnerable to severe pain after surgery, irrespective of which method of analgesia is used. However, PCA provides maximum benefit in terms of pain control for this group in comparison with the IMI method, and they should therefore be given priority in the allocation of PCA. A recent report [20] stated that traditional methods such as IMI are inadequate for controlling postoperative pain but the present findings indicated that im injections may offer relatively good control for patients with low levels of state anxiety. Indeed more recent evidence [21] suggested that IMI can generally be made more effective by reducing the time between injections. These findings have important economic and ethical implications because in the allocation of a relatively expensive resource such as PCA it is important to ensure that patients who would benefit most are those to whom it is given.

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