Retrospective Study

Differences in Pain Assessments Between Inpatients and Nurses Leads to Considerable Misestimated Pain

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Background: Pain assessments are an important aspect of health care quality because the high prevalence of pain in inpatients may contribute to complications. Several studies revealed a gap in the pain intensity evaluated by nurses (PEN) and patients (PEP). The aim of the present study was to analyze the correlation and agreement between pain assessments conducted by nurses and patients, and to determine patients at high risk of misestimated pain.

Objectives: To compare the difference of pain intensity between the questionnaires conducted by additional assessors and electronic records by nursing staff.

Study Design: A retrospective study.

Setting: A medical center in Taichung, Taiwan.

Methods: We approached 1,034 patients admitted from January 1, 2018 to December 31, 2018 in our hospital. We compared the assessments of pain intensity using questionnaires conducted by additional assessors with those entered into electronic records by nursing staff. Continuous data were reported as the mean (± standard deviation). The analysis of agreement and correlation were performed by kappa statistics or weighted kappa statistics, and correlation (Spearman rank correlation method).

Results: Among the 1,034 patients, 307 patients were excluded. Thus, the final analysis included 686 patients. Patients' median pain intensity was 5 in PEP and 1 in PEN. The patients' pain intensity was underestimated (PEN < PEP) in 539 patients (78.6%), matched (PEN = PEP) in 126 patients (18.3%), and overestimated (PEN > PEP) in 21 patients (3.1%). The surgical interventions (χ^2 = 7.996, and P = 0.018) and pain in the past 24 hours (χ^2 = 17.776, and P < 0.001) led to a significant difference.

Limitations: The limitation of the study was the single-center and retrospective design.

Conclusions: The gap in pain assessments between inpatients and nurses is an important issue in daily practice. The underestimations of pain were more common than overestimations (78.6% vs 3.1%). Surgical interventions and persistent pain lasting over 24 hours were high risk factors for underestimation, but patients' gender, receiving anesthesia, type of anesthesia, and patient-controlled analgesia did not contribute significantly to differences in pain estimation.

Key words: Pain, assessment, correlation, agreement

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Pain management is a significant issue for patients (1). Because pain affects not only the physical, the psychological, and the social dimension of patients' lives, it is also associated with negative changes in sleeping patterns, physical activity, and mood, and is associated with a decrease in social relationships and higher economical costs (2). Furthermore, pain is highly prevalent in hospitals (3,4). Approximately 30% of patients experience severe pain during hospitalization (5-8). The lifetime prevalence of postsurgical pain is high, and about 20% of patients develop chronic pain in the form of persistent postsurgical or posttraumatic pain (9-10). There was a higher prevalence of pain reported among women, younger patients, and patients who underwent surgeries (11-16). In order to achieve better pain treatment, a well-established pain assessment is crucial (17).

Pain assessment tools, such as the Numeric Rating Scale (NRS-11), Verbal Rating Scale, Visual Analog Scale, and the Faces Pain Scale-Revised, are commonly used in clinical and research settings (18,19). However, the usefulness of these pain assessment tools as an outcome measure is a matter of debate (20). Despite the increasingly widespread practice of routine screening, some studies (21,22) suggest that underestimation of pain occurs. Additionally, if routine screenings are not consistently used, the pain discordance is more prevalent, which has negative consequences for patients (23-25).

To explore the possible cause of misestimated pain, clinical practice should be discussed. The patients' verbal report of pain is a relatively reliable indicator of pain, and can be acquired by a team approach (26). In pain management teams, nurses play a key role due to their close and frequent contact with patients (27).

However, Shugarman et al (28) found that nursing staff reports of patient pain and patient self-reported ratings were often discordant. Moreover, nursing staff underestimated one quarter of all patients' pain and rarely overestimated it. A busy clinical environment may also interfere with nurses' documentation of pain scales (29).

In order to identify patients at high risk of pain being misestimated by nursing staff in our hospital, we obtained numeric rating scales of hospitalized patients using questionnaires administered by additional assessors. Our goal was to compare the differences in pain intensity between scores obtained by nursing staff and patients' self-reported scores.

Ethical Approval

The institutional review board (IRB) of Taichung Veterans General Hospital (TCVGH), Taichung, Taiwan, Republic of China, approved the study design on August 9, 2018 (IRB TCVGH No: CE18236B) and the informed consent form was obtained from the patient.

Methods

We approached 1,034 admitted patients from January 1, 2018 to December 31, 2018 in TCVGH (except intensive care unit, neonatology, pediatric intensive care, emergency room, and psychiatry) and questionnaires were administered by additional assessors. We matched patients' surveys with the last preceding electronic pain intensity records done by the nursing staff.

The trained assessors made their assessment using validated questionnaires. Simultaneously, assessors reviewed the patients' charts to collect demographic, medical data, and pain estimated by nurses. All pain ratings were based on a 0 ("no pain")-10 ("worst pain I can imagine") NRS-11; nurses' estimation of pain is hereafter referred to as PEN (pain intensity evaluated by nurse), while patients' self-reported pain is denoted by the abbreviation PEP (pain intensity evaluated by patient).

As a second step, the assessors retrospectively analyzed the pain scores obtained by the staff on the ward to establish the corresponding pain intensity nearest the time when the patients visited. In TCVGH, the pain was routinely measured by the nurses every 8 hours by means of the NRS-11 as well. This routine pain measurement focuses on assessment of the patient's pain when at rest. These scores were entered into the clinical database system.

The primary goal of our study was to assess the following PEN-PEP congruence features: agreement, correlation, and proportions of congruence categories (CCs: underestimation, congruence, and overestimation) (Table 1). The NRS-11 scores were first used to determine PEN-PEP differences and used analyses (agreement analysis with kappa or weighted kappa) to explore their correlation and agreement.

The secondary goal was to analyze the features in relation to independent category variables, namely, "congruence moderators" (Box 1). For these purposes, NRS-11 scores of both PEN and PEP were transformed into 4 pain categories: no pain (NRS-11 = 0), mild pain (NRS-11 $\geq$ 1 and $\leq$ 3), moderate pain (NRS-11 $\geq$ 4 and $\leq$ 6), and severe pain (NRS-11 $\geq$ 7), following Collins et al (31).

Finally, for each patient, PEN and PEP were com-

Table 1. *Distribution of moderators in PEN-PEP congruence category.*

Moderators		PEN-PEP Congruence Category (%)			Chi-Squared Test	
	No	Underestimation	Congruence	Overestimation	χ^2	*P* value
Gender						
Women	336	88.7	6.5	4.8	0.256	0.880
Men	350	89.1	6.9	4.0		
PEP Categories						
No pain	46	0	56.5	43.5	438.85	<0.001
Mild pain	158	81.6	12.7	5.7		
Moderate pain	190	99.5	0	0.5		
Severe pain	292	100	0	0		
Pain Experience in the Past 24 Hours						
No	240	82.1	10.4	7.5	17.776	<0.001
Yes	446	92.6	4.7	2.7		
Surgery						
No	256	85.2	10.2	4.7	7.996	0.018
Yes	430	91.2	4.7	4.2		
Anesthesia						
No	259	84.9	10.4	4.6	11.156	0.063
Local	62	88.7	6.5	4.8		
Regional	32	100	0	0		
General	333	91.0	4.5	4.5		
PCA Formula						
No	532	88.3	7.7	3.9	5.431	0.231
IVPCA	78	91.0	3.8	5.1		
PCEA	71	94.4	1.4	4.2		

Abbreviations: PEN: pain intensity evaluated by nurse; PEP: pain intensity evaluated by patient; PCA: patient-controlled analgesia; IVPCA: intravenous patient-controlled analgesia; PCEA: patient-controlled epidural analgesia.

pared to obtain the PEN-PEP congruence categories, including proportions of congruence (PEN = PEP), underestimation (PEN < PEP), or overestimation (PEN > PEP). Establishing the aforementioned congruence features enabled the evaluation of their relationship with independent variable categories like the PEP categories.

In addition to PEN, congruence moderators' information (Box 1) was provided by the assessors, and hence it may not necessarily coincide with the patient's opinion.

Box 1. *The Congruence Moderators*

1. Patients' demographic data
2. PEN categories (no pain, mild, moderate, and severe pain)
3. Patients' pain experience moderators: pain in the past 24 hours, surgery or not, or types of anesthesia
4. Pain treatment moderators: types of PCA or not

Data Presentation and Statistical Analysis

Continuous data were reported as the mean (± standard deviation). The analysis of agreement and correlation between PEN and PEP categories were performed by kappa statistics or weighted kappa statistics, and correlation (i.e., Spearman rank correlation method). When statistically significant, an absolute kappa value between 0.1-0.3 was considered as a mild agreement; 0.31-0.5 as a moderate agreement; and 0.51-1.0 as an excellent agreement. For the correlation analysis, when statistically significant, an absolute Rho (ρ) value between 0.2-0.4 was considered as a mild association; 0.41-0.7 as a moderate association; and 0.71-1.0 as a strong association. Finally, with respect to the congruence between moderators and different congruence categories, chi-squared test with Yates' correction test or Fisher's exact test as needed were performed. Statistical significance was defined as $P < 0.05$. All data

analyses were made using SPSS Statistics Version 23.0 (IBM Corporation, Armonk, NY).

Results

Among the 1,034 patients, 307 patients were excluded due to absence of or inability to evaluate NRS-11 by either the assessors or nurses. A total of 686 patients were included in the final analysis.

Patients' median pain intensity was 5 for PEP and 1 for PEN. In total, 430 patients (62.68%) and 365 patients (53.21%) received surgeries and anesthesia (general and regional anesthesia), respectively (Table 2). We categorized the raw data of PEP and PEN (Table 3) into no pain (NRS-11: 0), mild pain (NRS-11: 1-3), moderate pain (NRS-11: 4-6), and severe pain (NRS-11: 7-10) (Table 4). Pain intensity was underestimated (PEN < PEP) in 539 patients (78.6%), matched (PEN = PEP) in 126 patients (18.3%), and overestimated (PEN > PEP) in 21 patients (3.1%) (Table 4).

Table 2. *Demographic data (n=686).*

Age (mean ± SD)	56.8 (16.69)
Gender (M/W)	312/298
PEP (max/median/mean/min) (SD/IQR)	(10/5/5.58/0) (3/5)
PEN (max/median/mean/min) (SD/IQR)	(7/1/1.31/0) (1.16/2)
Clinical Conditions	
Surgery (Y/N)	430/256
Anesthesia (general/regional/LA/no)	333/32/62/259
PCA (Y/N)	144/542

Abbreviations: SD: standard deviation; PCA: patient-controlled analgesia; LA: local anesthesia; IQR: interquartile ratio; PEP: pain intensity evaluated by patients; PEN: pain intensity evaluated by nurses.

Table 3. *Distribution of NRS-11 in PEN and PEP.*

		PEN								Total
		0	1	2	3	4	5	6	7	
PEP	0	26	10	3	7	0	0	0	0	46
	1	10	4	6	0	0	0	0	0	20
	2	20	18	11	2	0	0	0	0	51
	3	32	18	31	5	0	0	1	0	87
	4	19	13	11	4	0	1	0	0	48
	5	40	13	24	16	0	0	0	0	93
	6	16	13	11	6	3	0	0	0	49
	7	20	15	20	8	2	0	0	0	65
	8	16	22	36	20	1	0	0	0	95
	9	11	5	15	12	1	0	0	0	44
	10	17	18	28	23	1	0	0	1	88
Total		227	149	196	103	8	1	1	1	686

Abbreviations: NRS-11: Numeric Rating Scale; PEN: pain intensity evaluated by nurse; PEP: pain intensity evaluated by patient.

Agreement and Correlation Between PEN and PEP

We analyzed the distribution and portions of different NRS-11 from PEN and PEP (Table 3). The agreement between PEN and PEP was not significant (kappa = -0.003, P = 0.729), while the correlation was found to be mild with statistical significance (rho = 0.268, P < 0.001). The pain intensity was then estimated by category. The distribution of pain intensity categories in PEN and PEP (Table 4) exhibited nonsignificant agreement (kappa = 0.008, P = 0.512) and a mildly statistically significant correlation (rho = 0.210, P < 0.001).

Congruence Moderators (Table 1)

Gender

Among the different congruence categories, either male or female patients had the highest proportion of underestimation, and the lowest proportion of overestimation (Table 1). Congruence categories dependence upon gender did not attain statistical significance (χ^2 = 0.256, and P = 0.880); major contributions for different genders were not associated with different congruence categories.

PEP Categories

The more severe pain the patients suffered from, the more likely the patients were to be in the category of pain underestimation; major contributions of different pain intensity categories were associated with different congruence categories with statistical significance (χ^2 = 438.85, and P < 0.001).

Pain Experience in the Past 24 Hours

According to the assessors' questionnaires, 446 patients (65.1%) suffered from pain in the past 24 hours, and a high-

Table 4. *Distribution of pain intensity category in PEN and PEP.*

		PEN				Total
		No Pain	Mild Pain	Moderate Pain	Severe Pain	
PEP	No pain	26	20	0	0	46
	Mild pain	62	95	1	0	158
	Moderate pain	75	111	4	0	190
	Severe pain	64	222	5	1	292
Total		227	448	10	1	686

Abbreviations: PEN: pain intensity evaluated by nurse; PEP: pain intensity evaluated by patient.

er proportion of these patients were in the category of pain underestimation compared with patients who did not suffer from pain in the past 24 hours (92.6% vs 82.1%). The difference in proportion in the different congruence categories attributed to different pain experience, which reached statistical significance (χ^2 = 17.776, and $P < 0.001$).

Surgery

In total, 430 out of the 683 patients received surgeries before visits by the assessors, and more of these patients had underestimation of pain intensity than those without surgeries (91.2% vs 85.2%). The differences between these 2 groups of patients among the different congruence categories were also statistically significant (χ^2 = 7.996, and P = 0.018).

Anesthesia

General or regional anesthesia seemed to contribute more to pain overestimation than local or no anesthesia at admission (> 91% vs < 89%), but the difference among the different forms of anesthesia were not statistically significant (χ^2 = 11.156, and P = 0.063).

Patient-Controlled Analgesia Formula

Although patients who received patient-controlled epidural analgesia had a higher proportion of pain underestimation than patients with intravenous patient-controlled analgesia (IVPCA) and without patient-controlled analgesia (PCA), the differences among different PCA formulae were not statistically significant (χ^2 = 5.431, and P = 0.231).

Discussion

Pain is often assessed and documented inadequately (32-34). While PEP appears to provide the most valid pain measure, observer-rated pain is often biased (35). A previous study (36) indicated that PEN is incongruent with PEP, including both under- and over-estimation. In our study, we found that PEP was frequently underestimated (78.6%), especially in the moderate and severe pain groups. In contrast, overestimation was relatively rare (3.1%). Clinically, overestimation is as harmful as underestimation. Underestimation leads to undertreatment, while overestimation exposes patients to overtreatment with potential treatment hazards (37).

Furthermore, some studies (38-40) have failed to show a relationship between pain assessment and patient outcome. Several studies (41-50) measured the agreement between patient- and nurse-reported pain intensity assessments. The results of these studies are inconsistent (41-50). The outcomes revealed a trend of higher NRS-11 scores correlating with a higher difference between PEP and PEN, meaning less accuracy of pain evaluation (51). Poor agreement was found between nurse and research pain ratings (52,53). In our study, poor agreement and correlation were recorded between PEP and PEN in NRS-11 or in the different pain intensity categories. The surgical interventions showed a significant difference. We also found that if pain was suffered by patients in the past 24 hours, the patients' pain would be more likely to be underestimated. Other factors, such as gender, receiving anesthesia, type of anesthesia, and PCA did not contribute to any significant difference.

The processes of pain recording included patients' reports, which were received by our medical team and then documented in a chart. There may have been inaccuracies that occurred during these processes. Firstly, with respect to the patients, some of them believed that pain was an inevitable part of their treatment. They were reluctant to report pain because they did not want to bother the clinician (54-57). In our clinical experience, Taiwanese people tend to endure pain without expressing it. The decline in patients' expression of pain may have led to an underestimation of pain by our medical staff. Furthermore, another interesting phenomenon was that patient satisfaction with pain management does not rely exclusively on pain relief. Patients' satisfaction with pain management is often paradoxical. For example, some patients may report

high levels of satisfaction despite experiencing severe pain at times. Satisfaction with pain management has been associated with communication and trust between patients and health care professionals, patients' expectations, preoperative fears, and the adverse effects of medications (56,57,59,60). The mismatch of satisfaction and pain may also contribute to a lower documented pain score. Patients should be encouraged to report their pain rather than concealing it so that they can receive better medical care.

Secondly, the systemic inadequacies in nursing practices (e.g., staff shortages, high workloads, and the perception of "we are nurses, they are doctors") are responsible for underdetection and undertreatment in many patients (61,62). Thirdly, different factors also appear to affect the clinical judgment of nurses, including their experience in listening, believing, and legitimizing the patient's pain, as well as their individual skills and abilities (63,64). Therefore, offering reasonable workloads and better training courses on pain are crucial to improve the gap in pain evaluations between patients and medical teams.

Finally, nursing staff in our hospital received regular training in each level for the evaluation of pain in their specialty and there was a standard operating procedure for the evaluation and management of pain documentation. The discrepancy between PEN and PEP may be attributed to the time intervals between PEN and PEP, which led to a difference in pain evaluations. This may be the reason why the difference occurred mostly on the occasions when the fluctuation of pain was frequent, such as in the patients with acute pain. However, in our study, the PEN and PEP were collected at time points that were as close as possible. Future research should obtain data using narrow time intervals in order to ensure precise outcomes.

Limitations

The PEN and PEP were collected at time points that were as close as possible, but the time intervals between PEN and PEP were still different and may have contributed to bias, such as analgesics may have been given during the interval. Moreover, the tenure of nursing staff was not recorded. Some research has revealed that staff with a longer duration of work experience are more likely to underestimate pain. A negative correlation was shown between years of work experience and accuracy of pain assessment among nursing staff (65-67). Both of the aforementioned phenomena could also contribute to bias. Further study may be needed in the future to provide more reliable data.

Conclusions

The misestimation of pain is an important issue in daily medical practice. The underestimation of pain was much more frequent than overestimation (78.6% vs 3.1%), especially in the moderate and severe pain groups. The surgical interventions and long-lasting pain over 24 hours were also risk factors of underestimation, while the patients' gender, receiving anesthesia, type of anesthesia, and PCA did not contribute to any significant differences. Both overestimations and underestimations of pain are harmful. We should encourage patients to report their pain rather than concealing it. In addition, the medical team, especially nursing staff, should be offered a more reasonable workload and better pain-related training courses.

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