

Hospital Cancer Pain Management by Electronic Health Record–Based Automatic Screening

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The all-cancer incidence rate in Korea started to decrease after 2012 (2012-2014, -6.6%), and overall cancer mortality has decreased 2.7% annually since 2002.¹ Nonetheless, pain remains among the most prevalent and distressing problems in patients with cancer. Optimal pain management contributes to improved survival and better quality of life.^{2,3} Therefore, pain management is a vital part of routine cancer care and has been advocated for by a multitude of professional organizations and institutions.⁴ Nevertheless, the undertreatment rate of cancer pain has been estimated at 43% globally⁵ and at up to 74% for Korean patients with cancer.⁶ Various factors contribute to pain undertreatment, including those related to patients, physicians, family, institutions, and society.^{7,8}

A cancer pain clinic (CPC) was first implemented in 2014 to improve the quality of cancer pain management in 1 cancer center in Korea. The mission of the CPC is comprehensive control of cancer pain during a patient's entire treatment period. For inpatients, an automatic screening system selects patients with uncontrolled cancer- or treatment-related pain. The CPC consists of 3 steps, designed according to the National Comprehensive Cancer Network guideline: assessment, management, and reassessment.³ This includes time-based assessment, pain-relief medication modifications, emotional support, patient education, assessment of drug adherence, and identification of adverse events during an initial face-to-face interview and follow-up visits (Table 1). Moreover, the CPC provides physician education concerning opioid prescriptions. All steps are recorded in the electronic health record (EHR) and shared with the attending oncologist. Considering the effects of cancer on patients and their families, the CPC also features the comprehensive care of patients and families. The CPC team consists of 3 family physicians with more than 3 years of experience treating patients with cancer and 1 oncology nurse practitioner.

Although this CPC service has been operating for 2 years, its effectiveness in managing cancer pain has not been formally examined. The aim of this study is to determine the success of the new CPC service at 1 cancer center in Korea.

ABSTRACT

OBJECTIVES: A cancer pain clinic (CPC) service is a thorough, comprehensive consultation service for patients with uncontrolled cancer pain. The aim of this study was to determine the success of a new CPC service with enrollment via electronic health record–based automatic screening at 1 cancer center in Korea.

STUDY DESIGN: A case-control study and a satisfaction survey.

METHODS: The intervention group (n = 158) was enrolled in the CPC service, whereas the control group (n = 158), which was matched using propensity scores, did not participate in the service. The pain scores of participants were compared using an independent *t* test. Thirty-nine patients and 20 physicians completed a self-administered survey on instructions for pain-relief medications, effective usage of long-acting and short-acting opioids, perceptions of or barriers to CPC services, knowledge of opioid use, and overall satisfaction.

RESULTS: Although the baseline pain score of the intervention group was significantly higher than that of the control group ($P = .013$), the difference in the decrease of pain between the groups was significant at days 1 ($P = .001$) and 2 ($P = .039$). Although the difference in pain scores disappeared on day 3, total pain score was significantly lower in the intervention group than in the control group ($P = .012$). When comparing pain relief events (<4 points on a 0-10 numeric rating scale that measured pain daily), the intervention group experienced more relief events than did controls ($P = .017$). Patients were satisfied with their physicians giving clear instructions and considering their opinions about pain-relief medications. The oncology residents expressed satisfaction with the management of patients with opioid-naïve or intractable pain.

CONCLUSIONS: The new CPC service seems to provide effective pain relief and users seem to be highly satisfied with it. These results support the importance of an integrated and specialized approach to cancer-related pain management.

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METHODS

This research involved a case-control study and a satisfaction survey of physicians and patients using a self-administered questionnaire. This study was approved by the institutional review board of Samsung Medical Center. The board waived the need for informed consent for the retrospective analysis of existing administrative and clinical data that do not include any identifiable personal information. All prospectively recruited subjects provided written informed consent.

Case-Control Study

Retrospective chart review of inpatients was conducted between October 2015 and June 2016. Pain assessment was based on an 11-point numeric rating scale (NRS) with 0 indicating no pain and 10 indicating the worst pain imaginable. The data were from EHR notes written by nurse practitioners 3 times each day. Patients whose pain was undertreated were defined by their meeting 1 or more of the following criteria: (1) moderate to severe pain (NRS score of 4-10) during the previous 24 hours despite pain medication, (2) severe pain (NRS score of 7-10) during the previous 24 hours, and (3) additional rescue medicine administered more than 3 times a day. When a patient met 1 or more of these criteria, the resident physician received an automatic notice requiring CPC consultation on their EHR screen. If the resident physician agreed to consult the CPC, the patient's information was automatically transmitted to the CPC team. If a patient received multiple consultations, we counted only 1 event.

Sample size was estimated based on the results of a pilot study, in which the intervention group took less than 0.32 days (less than 8 hours) to achieve diminished pain intensity to a score of less than 4 on the NRS using an independent *t* test with a type I error of .05 and a type II error of .20. The necessary sample size was estimated at 158 people per group. We selected 1 patient and 1 control using a propensity score for age (<40, 40-49, 50-59, 60-69, and >70 years), cancer site, and purpose of hospitalization, such as operation or medical treatment. The intervention group (*n* = 158) was defined as patients who followed the guidance of the pain management consultation. Controls (*n* = 158) were selected from patients with cancer who were hospitalized for the same purpose during the same period; they had not followed the guidance of CPC consultation, although pain intervention was indicated in this screening. The final analysis included 316 patients (18.4% of total screened patients). All patients were 18 years or older and had been admitted for cancer-related treatment, such as surgery, chemotherapy, radiotherapy, or supportive care.

TAKEAWAY POINTS

- ▶ A new cancer pain control program based on electronic health record–based automatic screening can efficiently select patients with uncontrolled pain and serve as a specialized and comprehensive consultation.
- ▶ We confirmed the quality of cancer pain clinic services via reduced pain scores in the early phase of treatment and reports of satisfaction among patients and physicians.

TABLE 1. Applied Cancer Pain Clinic Services for Inpatients and Oncology Residents in This Study

For oncology inpatients

- Automatic pain service consultation for patients with undertreated pain if physician approves
- Education for proper pain management with paper- and video-guided materials
- Ad hoc phone consultation in their home by nurse practitioner

For oncology residents

- Electronic pain assessment tool (eg, location, time-based record of intensity, analgesic administration, response to treatment)
- Electronic pain history sheet including analgesic history (regimen, dose, input site) and daily opioid dose
- Standard analgesic protocols for patients undergoing surgery
- Online education materials or lecture

NRS-ranked pain scores were collected by the EHR from the day of consultation (day 0) and the 4 following days (days 1, 2, 3, and 4). Pain assessment was performed 3 times a day. Therefore, each value or mean daily pain score was used in this analysis. Information on age, sex, diagnosis, treatment, purpose of hospitalization, and pain intensity was obtained via EHR review by the nurse practitioner.

Satisfaction Survey Completed by Patients With Cancer and Physicians

Sample size was estimated based on effect size (0.50) as a difference of response, and SD of physician responses (0.30) and patient responses (0.20) using a *t* test with a type I error of .05 and a type II error of .20. The necessary sample size was estimated at 18 physicians and 37 patients. A satisfaction survey was prospectively completed by 39 patients who had at least 1 previous CPC visit and by 20 resident oncology department physicians. The self-administered questionnaire was answered between September 2016 and December 2016. Information on the training grade (eg, first-year, second-year) and sex of residents and age and sex of patients was obtained. The satisfaction questionnaire was modified from a previous satisfaction survey.⁹ The patient survey consisted of 9 statements regarding user instructions for pain-relief medications, appropriate usage of long-acting and short-acting opioids, communication with the physician, and overall satisfaction. The physician survey also consisted of 9 statements. At the beginning, there was a yes/no preliminary screening question, "Have you ever asked for CPC consultation for your patients with uncontrolled pain?" If they answered yes, we investigated the perceptions of

TABLE 2. Baseline Characteristics of Participants in Case-Control Study (N = 316)

	Intervention Group (n = 158)	Control Group (n = 158)	P
Age, years, mean ± SD	58.7 ± 12.1	59.6 ± 10.3	.472
Sex, n (%)			>.999
Male	112 (70.9)	112 (70.9)	
Female	46 (29.1)	46 (29.1)	
Hospitalization, n (%)			>.999
Surgery	103 (65.2)	103 (65.2)	
Other ^a	55 (34.8)	55 (34.8)	
Cancer site, n (%)			.116
Lung	27 (17.1)	27 (17.1)	
Pancreas	25 (15.8)	26 (16.5)	
Colon	23 (14.6)	23 (14.6)	
Liver	22 (13.9)	21 (13.3)	
Esophagus	17 (10.8)	17 (10.8)	
Head and neck	13 (8.2)	13 (8.2)	
Other ^b	31 (19.6)	31 (19.6)	

^aOther purposes of hospitalization included chemotherapy, radiation therapy, and supportive care.

^bOther cancer sites included gynecology, prostate, breast, kidney, bladder, and other cancer sites and types.

FIGURE. Variances of Pain Scores in the Intervention and Control Groups^a



NRS indicates numeric rating scale.

^aValues in table represent mean ± SD NRS scores. Each *P* value was calculated using an independent *t* test, and a *P* value <.05 was significant during days 0 to 2. The intervention group showed a greater reduction in pain than the control group by a mixed model (*P* = .012). Day 0 is the day of consultation and the 4 following days are days 1 to 4.

and barriers to CPC services, difficulty of pain management, their knowledge of opioid use, and overall satisfaction. If they answered no, we investigated the reasons why they did not request CPC consultation using 5 choices: (1) I have never received a notice that required a CPC consultation from the EHR, (2) I don't know the role of the CPC, (3) I can manage by myself, (4) the process of consultation is too complicated, and (5) when I ask for CPC consultation, I have to get permission from a senior doctor. All answers were captured via a 5-point Likert scale from strong agreement to strong disagreement.

Statistical Analyses

Descriptive statistics are expressed as mean (SD) for continuous variables and number (proportion) for categorical variables. These data were compared using Student's *t* test and the χ^2 test. After confirming no sphericity in repeated measures analysis of variance using Mauchly's test of sphericity, we performed univariate analysis revised by the Greenhouse-Geisser method.¹⁰ The daily NRS values between the intervention and control groups were compared using an independent *t* test. The interaction effect between time and group was estimated using a mixed model. NRS time and group values were considered as fixed effects, and patients were considered as random effects. Additionally, the interaction effect between time and events of pain relief, with "pain relief" defined as a score at any point of less than 4 points on the NRS, was estimated using the generalized estimating equation model.

For the satisfaction survey, the responses are presented as percentages. All analyses were performed using PASW Statistics 23.0 software (SPSS Inc; Chicago, Illinois). Two-sided *P* values are given.

RESULTS

Table 2 presents comparative data of the participants. Among the 316 participants, including patients with lung, pancreas, colon, liver, and other cancers, there were no differences in age, sex, or purpose of hospitalization between the intervention and control groups. The initial pain intensity of the intervention group was higher than that of controls (mean [SD] NRS value, 5.23 [1.20] vs 4.85 [1.44]; *P* = .013) (**Figure**). Both the intervention and control groups showed decreased pain scores during the observation period (day 4 NRS scores, 3.66 [1.48] vs 3.85 [1.36]; *P* = .431). However,

the pain intensity of the intervention group on days 1 and 2 was significantly lower than that of the controls (all *P* <.05). The pain intensity reduction of the intervention group was approximately 30%, as shown in the Figure. The interaction between measurement time and group was statistically significant (*P* = .012). Comparing pain relief events (NRS score of <4 points), the intervention group had more relief events than did controls (*P* = .017). Mean (SD) pain relief times to achieving a score of less than 4 points on the NRS in the intervention group and control group were 0.93 (0.75) and 1.28 (1.00) days, respectively. Therefore, the intervention group had

shorter duration to pain relief than the control group ($P = .015$).

The patient survey involved 39 patients (Table 3). Their mean (SD) age was 58.9 (12.4) years, and 33% were female. More than 84% of patients were satisfied with CPC services separate from the oncology department. In particular, high satisfaction with the instructions they received concerning pain-relief medications and their communications or relationships with CPC physicians was evident. They agreed that CPC physicians gave clear instructions about pain-relief medications, considered their opinions, and fully discussed issues with them. They clearly understood the instructions of CPC physicians. Most (82%) of the patients would recommend CPC services to other patients.

In a survey of 24 oncology residents, 83% had experience with CPC services. The 4 responders (17%) who did not ask for CPC services felt they could manage on their own; they were thus excluded from further analysis. The responses of the 20 remaining residents (55% female) are presented in Table 4. Their satisfaction rate was 80% concerning management of opioid-naïve patients and intractable pain, which was difficult to control. Mostly, they agreed that the CPC service was helpful for managing the adverse events (AEs) of pain-relief medications and that pain management was easy. However, only 65% of them knew that patients should take short-acting pain-relief medications to manage breakthrough pain, even when cancer pain was well controlled. Moreover, half of the residents expressed difficulty in deciding on the type and amount of pain-relief medications and 40% expressed difficulty in managing known AEs of pain-relief medications (eg, nausea, drowsiness). Sixty-five percent of the physicians intended to recommend CPC services to their colleagues or patients.

DISCUSSION

In this case-control study and survey, the CPC program with EHR-based automatic screening provided effective pain relief in the early phase of treatment. Moreover, improvements in the quality of cancer pain management involved patients, family, physicians, and

TABLE 3. Responses to Satisfaction Survey by Oncology Patients (n = 39)

Statement	%		
	Always or Mostly Agree	Uncertain	Disagree or Absolutely Disagree
The CPC physicians gave me clear instructions about the amount of pain-relief medications to take.	97.4	2.6	0
The CPC physicians gave me clear instructions about when and how I can use pain-relief medications.	97.4	2.6	0
The CPC physicians explained to use long-acting and short-acting pain-relief medications separately.	94.9	2.6	2.6
The instructions of the CPC physicians were easy to understand.	94.9	2.6	2.6
The CPC physicians considered my opinions about pain-relief medications.	100	0	0
When I asked questions of CPC physicians, they spent enough time to answer them.	97.4	2.6	0
When I wanted to contact CPC physicians, I could do so.	89.7	7.7	2.6
I am satisfied with pain management in CPC, apart from the oncology department.	84.6	10.3	5.1
I recommend CPC services to other patients with cancer.	82.0	15.4	2.6

CPC indicates cancer pain clinic.

TABLE 4. Responses to Satisfaction Survey by Oncology Residents (n = 20)

Statement	%		
	Always or Mostly Agree	Uncertain	Disagree or Absolutely Disagree
I am more confident in initiating or managing new patients on opioids when the CPC team is involved.	80.0	15.0	5.0
CPC consultation was helpful in management of intractable pain.	80.0	15.0	5.0
CPC consultation was helpful to manage negative adverse effects of pain-relief medications.	60.0	30.0	10.0
It was easy to ask for a consult and apply the recommendations of CPC physicians.	65.0	30.0	5.0
I have been hesitant to apply the recommendation of CPC physicians for my patients.	10.0	15.0	75.0
I don't have any difficulty deciding on a type and amount of pain-relief medication.	20.0	30.0	50.0
I don't have any difficulty managing some adverse events of pain-relief medications.	20.0	40.0	40.0
Even when cancer pain is well controlled, patients should take short-acting pain-relief medications to control breakthrough pain.	65.0	35.0	0
I would recommend to my colleagues and patients to take CPC consultation.	65.0	35.0	0

CPC indicates cancer pain clinic.

institutions. The CPC service was quite satisfactory to patients and oncology residents.

Pain is a complex and multidimensional experience that consists of sensory and affective dimensions. Cancer pain can be regarded as “total pain,” composed of physical, psychological, spiritual, and social dimensions, including personal values and family relationships.^{11–13} Therefore, each component has to be an integral part of holistic treatment.¹⁴ Because of the complexity of cancer pain, optimal treatment has several suggested components. First, individual patient education must include the correction of biased views on opioid use to improve outcomes of pain management and medication adherence.¹⁵ Second, effective doctor–patient communication is important in considering patients’ preferences and ensuring shared decision making.¹⁶ In particular, patients profess high satisfaction with physicians who are able to spend extended time with them during the integration of pain management and early palliative care.¹⁷ CPC physicians, as family physicians, would have a good understanding of their patients’ personal values and family relationships. Third, proper development of steps can help avoid overlooking patients and not properly treating their pain in the setting of a busy, crowded hospital. Overall, this CPC service was well received by patients and oncology residents and achieved effective pain relief for the patients. Follow-up visits by CPC physicians helped to relieve pain effectively.¹²

A reduction of approximately 30% in pain intensity in the intervention group from baseline to the end point was acceptable as a clinically important difference.¹⁸ However, the effective difference of pain relief was found after only 2 days of treatment. We believe that the reason for this finding is that this hospital already applied a clinical care pathway for pain management according to the patient’s cancer diagnosis. Nonetheless, given the difference in pain intensity between the intervention and control groups, CPC services would compensate for insufficient clinical care pathways in the initial period.

Previously suggested barriers to cancer pain management have included lack of understanding of pain assessment and management, patient fear of opioids, inadequate delivery systems, and inadequate outcome measures.^{4,17,19,20} Patient-perceived barriers to using supportive care services included lack of physician referral (23%), followed by lack of patient knowledge (22.4%).²¹ The additional fee was not a large barrier (8.3%). In this study, we confirmed that although patients have to pay the CPC consultation fee, they are satisfied with pain management in CPC, separate from the oncology department. Korean oncology physicians assume full responsibility for cancer treatment and symptom management, including pain, which differs from the pharmacist-based American system.⁴ In one study, 463 surveyed Asian oncology physicians overwhelmingly did not prefer patient referral to a pain specialist (83.6%) because they perceived that the pain specialist had an inadequate understanding of cancer (33.1%).²² Therefore, training to build CPC teams is of the utmost importance to establish a cooperative pain control program in Korea.^{17,21}

Limitations

The present study has some limitations. First, this study was conducted at a single academic institution. Therefore, the findings should not be taken as representative of or generalizable to other practice settings. However, in an institution similar to an academic hospital, CPC would be expected to improve cancer pain management. Second, this study had inherent concerns with regard to incomplete information, including cancer stage, physical performance, and patient education level. Third, the effectiveness of pain management was assessed by matched pairs in subjects with poor pain control. Therefore, the cancer site distribution of participants may have been biased, as pain in highly prevalent thyroid, breast, and gastric cancers does not generally cause severe pain. Lastly, although the satisfaction survey tool was revised based on previously published survey tools used in the literature, it was not validated for evaluating cancer pain management services. Administering the satisfaction survey to patients receiving CPC but not the controls was considered a limitation.

CONCLUSIONS

A CPC program for inpatients implemented at an academic cancer center in Korea provided effective pain relief and achieved high satisfaction among patients and oncology residents. These results support the importance of an integrated and specialized approach to cancer-related pain management. Further research is needed to determine the long-term efficacy of CPC services to control cancer pain. ■

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