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Clinical Article

Implementation and Outcomes of a Critical Pathway for Lumbar Laminectomy or Microdiscectomy

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Objective : The aim of this study is to implement a critical pathway (CP) for patients undergoing lumbar laminectomy or microdiscectomy and describe the results before and after the CP in terms of length of hospital stay and cost.
Methods : From March 2008 to February 2009, 61 patients underwent lumbar laminectomy or microdiscectomy due to stenosis or one- or two-level disc herniation in our department and were included in the prepathway group. After development and implementation of the CP in March 2009, 58 patients were applicable for the CP, and these were classified as the postpathway group.
Results : The CP, which established a 6-day hospital stay (5 bed-days), was fulfilled by 42 patients (72.4%) in the postpathway group. The mean length of stay was 5.4 days in the postpathway group compared to 6.9 days in the prepathway group, demonstrating a 20% reduction, which was a statistically significant difference ($p \leq 0.000$). There was a statistically significant reduction in charges for bed and nursing care ($p=0.002$).
Conclusion : Implementation of a CP for lumbar laminectomy or microdiscectomy produced significant decreases in length of hospitalization and charges for bed and nursing care. We believe that this CP reduces the unnecessary use of hospital resources without increasing risk of adverse events.

Key Words : Critical pathway · Clinical pathways · Laminectomy · Microdiscectomy.

INTRODUCTION

Clinical or critical pathways (CP) are standard comprehensive management systems that provide routine day-to-day care plans and multidisciplinary services from medical care to physical therapy and rehabilitation. CP in the medical field can best be defined as an "optimal sequencing and timing of interventions by physicians, nurses, and other staff for a particular diagnosis or procedure"[2]. They were originally adapted from engineering fields, where they are used to increase efficiency and provide a timeline for job completion. They were slightly modified in the medical field to improve cost-effectiveness and reduce complication rates in specific patient groups. The benefits of CP have been consistently reported to be as follows : 1) they promote patient and family satisfaction with care by providing detailed information on the treatment process and thereby enhance collaboration; 2) they improve job performance and the satisfaction of care team members via multidisciplinary communication and teamwork; 3) they provide systematic and qualified patient care, which reduces hospital stays and costs; and 4) they provide a basis for estimating treatment costs.[8] Above all, the chief economic benefit of pathways is reduction of cost by formulating a standard care plan that minimizes the use of unnecessary resources.

Previous studies have found that CP for various medical procedures can lead to decreases in costs and length of hospital stay[3,4,12,15,17,18]. Theoretically, they should be most effective in commonly performed procedures for which volume and popularity are high. Lumbar laminectomy or microdiscectomy without instrumentation are the most commonly performed elective spine surgeries in Korea for their simplicity and effectiveness for benign spine disease. However, the absence of specific protocols for lumbar laminectomy or microdiscectomy despite their surgical popularity results in unjustifiable variability among professionals involved in benign spine disease. In this context, it seems relevant to create and implement a CP for these kinds of surgery. This is especially important in some environment, where reimbursement for hospital care is on a diagnosis related group episode base. In Korea, the diagnosis related group-oriented CP was adopted in 1997 and has been in expansion[11].

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We present our experience with the implementation of a CP for lumbar laminectomy or microdiscectomy without instrumentation. The aim of our study was to describe the results before and after the CP, particularly in regards to length of hospital stay and cost for the participating patients.

MATERIALS AND METHODS

CP implementation

There have been no CPs developed for lumbar laminectomy or microdiscectomy to date; therefore, a CP to assist in the management of patients undergoing these surgeries was developed by a committee that consisted of 3 spine surgeons, 2 nurses, a pharmacist, a nutritionist, and representatives from the hospital administration. The preliminary elements of the CP were determined after review of medical records of the patients who had previously undergone laminectomy or microdiscectomy at our institute, and then they were modified with the assistance of the aforementioned committee. Table 1 presents the CP developed during the present study. After development and approval by the medical executive committee in our hospital, the pathway was instituted in March 2009. No specific individuals were designated to "enforce" this pathway.

Patient groups

From March 2008 to February 2009, 61 patients underwent lumbar laminectomy or microdiscectomy due to stenosis or one- or two-level disc herniation by 3 neurosurgeons in our department and were included in the prepathway group. The prepathway group was composed of 38 men and 23 women with a mean age of 51.3 years, ranging from 26 to 80 years. After implementation of the CP for lumbar laminectomy or microdiscectomy, 70 patients were admitted for operations related to lumbar disc-related pathology from March 2009 to February 2010. Application of the CP was feasible in 58 of 70 patients, and these 58 patients were classified as the postpathway group. Twelve patients were excluded due to the following causes : 2 patients with more than 3 levels requiring lumbar laminectomy; 3 patients with grave medical comorbidities, such as coronary heart disease or chronic obstructive pulmonary disease,

Table 1. Critical pathway for lumbar laminectomy or microdiscectomy without instrumentation

	Admission Day	Operation Day	POD #1	POD #2	POD #3	POD #4
Procedure	Consent for operation	Check drainage Check L/Ex SMC Check I & O Check wound	Check L/Ex SMC Check I & O including drainage volume Check wound	Check L/Ex SMC Check I & O including drainage volume Check wound	Check L/Ex SMC Check I & O including drainage volume Check wound	Check L/Ex SMC Check I & O including drainage volume Check wound
Activity		Absolute bed rest	Encourage ambulation	Ward ambulation	Ward ambulation	Ward ambulation
Diet	Regular diet	MN NPO SOW ≥SD 4 hr after operation	Regular diet	Regular diet	Regular diet	Regular diet
Treatment			Wound dressing Foley catheter removal Removal of draining tube	Wound dressing		Wound dressing Stitch out at POD #7
Medication		DNK21L+tamipol@ XRANI 1@ IV q8hr XAMBR 1@ IV 8hr XHEMO 1@ IV 8hr IV Cefazolin IV analgesics (Routine and prn)	DNK21L+ tamipol 1@ XRANI 1@ IV q8hr XAMBR 1@ IV q8hr XHEMO 1@ IV q8hr IV Cefazolin IV analgesics (Routine and prn)	DNK2 D/C XRANI 1@ IV q8hr XAMBR 1@ IV q8hr XHEMO 1@ IV q8hr IV Cefazolin D/C IV analgesics (prn) PO analgesics	IV analgesics (prn) PO analgesics	IV route removal PO analgesics
Diagnostic test	CBC, ESR, CRP, AT/APTT, Electrolyte test, liver profile, ECG, Chest X-ray, Lumbar X-ray			CBC, ESR, CRP, Lumbar AP/lateral X-ray		
Education	Preoperative education,	Deep breathing Active cough Use of inspirometer Position change-log rolling	Orthosis wearing (prn) L/Ex SLR exercise	Orthosis wearing (prn) L/Ex SLR exercise	Orthosis wearing (prn) L/Ex SLR exercise	After discharge Wound dressing, Stitch out Take a shower Follow-up visit

CBC : complete blood count, ESR : erythrocyte sedimentation rate, CRP : C-reactive protein, APTT : activated partial thromboplastin time, ECG : electrocardiogram, L/Ex : lower extremity, SMC : sensory motor and circulation, I & O : input and output, MN NPO : nothing by mouth after midnight, SOW : sips of water, SD : soft diet, DNK2 : 5% dextrose with NaCL and KCL in 1000mL bag, XRANI : ranitidine, XAMBR : ambroxol, XHEMO : hemocoagulase, prn : as needed, PO : oral, SLR : straight leg raising test, AP : anteroposterior, POD : postoperative day

which prolong total hospital stay for preoperative risk evaluation or treatment and postoperative medical care; 4 patients with active infectious status including spondylodiscitis; and 3 patients with definite wish not to be designated to a CP. The postpathway group was composed of 33 men and 25 women with a mean age of 49.6 years, ranging from 18 to 76 years. Patients with radiculopathy are more common than those with stenosis in both groups (Table 2). There were no statistically significant differences in group composition in terms of age, sex, and primary diagnosis (radiculopathy or stenosis). Three spine surgeons with at least 5 years of experience performed the operations. There were no significant differences in the surgical techniques among the surgeons.

Data collection and analysis

Data collected for analysis included patient demographics, primary diagnosis with comorbidities, length of hospital stay, costs during hospitalization from a fiscal database, and clinical outcomes with patient satisfaction for 61 patients before and for 58 patients after pathway implementation, respectively. The impact of the CP on length of hospital stay, hospital charges, and clinical outcomes was assessed by comparing the data from both groups. Comparisons were made using independent t-test or Mann-Whitney U test according to normality in data distribution. Statistical analysis was performed using PASW statistical software ver. 18.0 (SPSS Inc, Chicago, IL, USA). *p*-values less than 0.05 were considered statistically significant.

RESULTS

The CP was feasible for 58 among 70 patients admitted for lumbar disc disease; the CP coverage was 83%. The CP in this study established a 6- day hospital stay (5 bed-days), a time that was fulfilled by 42 patients (72.4%) in the postpathway group. Data concerning length of hospital stay are presented in Table 3. The mean length of stay was 131.5±35.0 hours (5.4 days) in the postpathway group compared to 164.5±54.8 hours (6.9 days) in the prepathway group, demonstrating a 20% reduction in the postpathway group, which was a statistically significant intergroup difference ($p \leq 0.000$). Data concerning hospital bills are also presented in Table 3. The total hospital bills were analyzed by selected categories, such as bed and nursing care charge, drug and prescription-related charge, operation-related fee, and charge for laboratory and imaging test. The mean total hospital bill was ₩2809027 (₩ is for Korean currency, Won) for those in the prepathway group and ₩2769039 for patients in the postpathway group. The difference in total hospital bill was not statistically significant ($p=0.815$). There was a statistically significant reduction in charges for bed and nursing care ($p=0.002$). However, drug and prescription-related charges and operation-related fees in the postpathway group were slightly increased ($p=0.112$ and $p=0.283$, respectively). The charge for laboratory and imaging test was not different between two groups ($p=0.573$).

There were several special events in the course of pre- and postoperative care for the patients of prepathway group. Two patients with the past medical history of diffuse atherosclerotic change in aorta and myocardial infarction were transferred to another department and treated for those problems. For above two patients, the length of stay and total hospital bills were counted until they were in our department. Two days of bed rest after surgery was prescribed for two patients with intraoperative leak of cerebrospinal fluid. There was one patient complaining persistent tingling sense after microdiscectomy on ipsilateral leg. However, the symptom was improved progressively during 10 days hospitalization. There were 3 cases of adverse event in the postpathway group. One patient complaining of weakness on ankle motion after microdiscectomy spent three days doing physical rehabilitation. Two cases of wound dehiscence without elevation of ESR/CRP occurred before discharge. The wound problems were resolved by simple repair followed by prescription of oral antibiotics.

Table 2. Summary of patient characteristics

Characteristics	Prepathway (n=61)	Postpathway (n=58)
Age	51.3±15.4 years (mean±SD)	49.7±16.7 years (mean±SD)
Sex		
Male	38	33
Female	23	25
Radiculopathy	39	37
Stenosis	22	21

SD : standard deviation

Table 3. Comparison of National Health Insurance reimbursement variables between the prepathway group and the postpathway group

	Prepathway	Postpathway	Change (%)	*p*-value†
Length of hospitalization (hours)	164.5±54.8 (6.9 days)	131.5±35.0 (5.4 days)	-20	0.000*
Total hospital bill (Won)	2809027±709930	2769039±460042	-1	0.815
Bed and nursing care charge (Won)	566727±191265	478431±140537	-15	0.002*
Drug and prescription-related charge (Won)	241878±59386	251586±62464	+4	0.112
Operation-related fee (Won)	1301288±325237	1339740±213372	+3	0.283
Charge for laboratory and imaging test (Won)	699133±405143	699281±327945	0	0.573

Values are mean±standard deviation. *Statistically significant values, †Comparisons were made using Mann-Whitney U test

We also investigated the postpathway patients' satisfaction levels at an outpatient visit 6 months postoperatively via a specific indicator developed for another clinical pathway in our hospital, and we achieved good results with a high satisfaction rate (Table 4).

Table 4. Patient satisfaction after the critical pathway

	Degree of satisfaction (%)
Are you satisfied with the information you received on admission?	87
Are you satisfied with the information about process of examinationand examination itself?	83
Do you consider the education before operation to be enough?	93
Do you consider the explanation about operation to be adequate?	90
Are you satisfied with the nursing care during hospital stay?	93
Do you think that the flow of whole process is smooth?	80

DISCUSSION

In this study, we developed and implemented a CP to aid in the care of patients undergoing lumbar laminectomy or microdiscectomy without instrumentation. It was noted that the length of hospital stay was significantly decreased in patients in the postpathway group compared to the prepathway group. According to this reduction in the length of hospitalization, bed and nursing care charge was also decreased with statistical significance in the postpathway group. However, a 4% increase in drug and prescription-related charge and a 3% increase in operation-related fee were noted for the postpathway group, which were statistically not significant.

There was no remarkable increase except wound problems in postoperative complications in the postpathway group compared to the prepathway group. These adverse events are thought to be caused by earlier discharge than in the previous protocol, in which daily dressing of surgical wound and stitch out were carried out within the hospitalization. It is important to document that complication rates did not increase in the setting of the CP. With the goal of improving quality of care, implementation of CP as a means of providing cost-effective care and decreasing the use of hospital resources should not increase perioperative complications. Several studies have reported that the incidence of postoperative complications decreases following introduction of a CP system[9,10]. Checking of the observation endpoints for a CP might contribute to preventing the occurrence of complications[14]. It should thus be noted that a CP is primarily intended not solely to reduce medical costs and the duration of hospitalization but to improve quality of medical care through minimizing the potential risk of malpractice.

To our knowledge, this is the first analysis of a CP specific to laminectomy or microdiscectomy without instrumentation, which are some of the most popular surgical procedures in the world. There was only one report in Pubmed dealing with the subject of a CP for herniated lumbar disc[7]. The scarcity of reports on the CP might be influenced by general criticism for their potentially negative impact on patient care[16]. Cost-focused CP with an emphasis on reduced hospital stays may conceivably result in reduced quality and more readmissions even though a few studies have reported that pathways help the process of quality improvement[6,13].

Several changes and improvements, such as a significant reduction in the duration of hospitalization and a slight decrease in total hospital bill, were accomplished without raising the potential risk of postoperative complications as a result of CP in this study. However, there were some obstacles encountered during pathway implementation. The most crucial factors were the insufficient understanding of the CP among the healthcare staff and unwillingness of most Korean patients to be discharged earlier than they expected. Residents, who prescribe the daily orders and are mainly in charge of implementing the pathway, tend to see the clinical pathway as optional. Furthermore, most Korean patients who received an operation in the hospital would like to be discharged from that hospital when the wound pain is completely disappeared and wound dressing is removed after stitch-out. This is why the length of hospital stay is still long compared with that in other countries. We know that many discectomies are performed on an ambulatory basis in the U.S. and the mean length of stay for those who are hospitalized is less than three days[5]. It is a cultural difference in surgical practice. Most of all, the recognition of the general overview of the treatment course and the significance of the CP are crucial for the CP to be implemented under optical conditions.

There were several limitations to this study. This was not a prospective, randomized controlled study; longer follow-up with a larger patient group are needed to provide further evidence of the value of the CP in intervertebral disc disease. It is probable that the CP for benign spinal disease produced a positive effect on patient satisfaction. However, it is difficult to draw a solid conclusion about relative patient satisfaction between the groups because there was no assessment of satisfaction in the prepathway group even though the postpathway patients were assessed for satisfaction levels as well as clinical improvements at an outpatient visit 6 months postoperatively. Finally, it would be more meaningful to compare the prepathway and postpathway patients under the consideration of workers compensation which is known for negative risk factor for improvement after back surgery[1].

CONCLUSION

Implementation of the pathway for lumbar laminectomy or microdiscectomy produced significant decreases in length of hospitalization and charge for bed and nursing care in the pathway group as compared to the prepathway group. We have been continuing to recruit patients to strengthen our results supporting the value of the CP for simple lumbar disc disease. We believe

that this CP reduces the unnecessary use of hospital resources without increasing the risk of adverse events and supports the development of CPs for other spine surgeries.

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