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ORIGINAL ARTICLE

Effect of Early Postoperative Rehabilitation on Length of Hospital Stay after Robot-assisted Radical Prostatectomy

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Objectives: This study assessed how early postoperative rehabilitation interventions affected the duration of hospital stay in patients with prostate cancer who had radical prostatectomy with robotic assistance. **Methods**: From the Japanese Diagnosis Procedure Combination database, we extracted case data for patients discharged between April 2014 and March 2020. Patients were recognized by code C61 from the International Classification of Diseases, 10th Edition. We ran a multilevel linear regression analysis to investigate the impact of early rehabilitation on the duration of hospital stay. **Results**: There were 2151 participants in the trial. In patients with prostate cancer who had resection utilizing robotic-assisted devices, early rehabilitation was related to a substantial decrease in duration of hospital stay (coefficient, −0.86; 95% CI, −1.64 to −0.07; P=0.032). **Conclusions**: Early postoperative rehabilitation may contribute to shorter hospital stays in patients with prostate cancer at high risk of both postoperative complications and a decline in their ability to perform activities of daily living.

Key Words: length of stay; postoperative care; prostate cancer; rehabilitation; robotic surgical procedures

INTRODUCTION

Prostate cancer is most common among men in their 50s to 70s,[1] and the number of patients with prostate cancer in Western countries is on the rise. A survey conducted in 2018 found that prostate cancer is the most commonly diagnosed cancer in 105 countries, including in the Americas, Northern Europe, and Western Europe.[2] According to a survey by the National Cancer Center of Japan, the incidence of prostate cancer (per 100,000) in Japan, which has a declining birthrate and aging population, has doubled over the past decade from 69.0 in 2005 to 128.8 in 2015.[3] In addition, prostate cancer-related costs in Japan are estimated to increase by 1.1-fold from 390.8 billion yen in 2017 to 434.9 billion yen in 2029.[4] Therefore, the delivery of efficient medical services is a challenging task under the burden of increased public expenses.

If a prostate tumor is confined to the prostate and the patient is in good general condition, surgery is usually the treatment of choice.[5] In Japan, robot-assisted radical prostatectomy (RARP) was approved for insurance coverage in 2012. This procedure has become common, reducing the mean hospital length of stay (LOS) and making outpatient surgery more common in Western countries.[6–8] In contrast, surveys conducted in Japan have shown that patients with prostate cancer usually require more than 10 days of hospitalization postoperatively, with a trend toward longer hospital stays for those over 75 years of age.[9] Postoperative complications have been shown to be the main factor affecting postoperative hospital LOS,[10,11] and postoperative

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rehabilitation is commonly implemented in many areas as a countermeasure. A systematic review investigating the effects of early rehabilitation in patients after heart and joint surgery found that it can reduce the number of postoperative hospital days.[12,13] However, given that RARP in the USA and Europe is generally performed as outpatient surgery and few patients require long-term hospitalization, the effect of rehabilitation on LOS has rarely been examined. A study conducted by Cao et al.[14] showed that rehabilitation after RARP contributed to shorter LOS. However, the study was limited by the fact that the control group received no rehabilitation and by being conducted at a single institution. Although LOS tends to be longer in Japan than in other countries, the number of cases requiring rehabilitation at a single facility is small, and there have been no reports to date that have examined the impact of early rehabilitation on LOS using a large database. Therefore, the purpose of this study was to clarify the impact of early rehabilitation intervention on LOS in patients with prostate cancer undergoing RARP.

MATERIALS AND METHODS

Study Design

This study was a retrospective observational study using the Japanese Diagnosis Procedure Combination (DPC) database. DPC data are available for all 82 university hospitals, and an additional 1600 acute care hospitals have voluntarily signed up to the DPC database. This means that DPC data covers 1682 hospitals out of a total of 3633 in Japan. Therefore, DPC data are available from 46% of acute care hospitals in Japan. We used case data for patients discharged between April 2014 and March 2020. This study design was approved by the institutional review board of the University of Occupational and Environmental Health, Japan (R2-007), which deemed that written informed consent from participants was not required.

Patient Selection

Patients with prostate cancer, classified under the International Classification of Diseases 10th Edition (ICD-10) code C61, who underwent RARP were included in this study. The following exclusion criteria were used: (1) recurrence of cancer, (2) metastasis, (3) Barthel Index (BI) at admission less than 100, (4) death during hospitalization, and (5) missing data.

Although the Activities of Daily Living (ADL) score is not strictly a BI, we decided to use the ADL score to calculate the BI in this study because the endpoints are very similar. Given that only patients with a BI of 100 were included in this study, even patients with a deduction of only 1 point were excluded.

Primary Outcome

The primary outcome of this study was the postoperative LOS in hospital.

Patient Characteristics and Variables

The DPC database allows for the acquisition of patient background information, types of surgeries, information on hospital admissions and discharges, and other medical-related information. However, the database is characterized by an inability to provide data on imaging findings and biochemical tests.

We extracted the following items from the database: age, body mass index, T stage classification, Charlson Comorbidity Index (CCI), comorbidities (type 2 diabetes mellitus, benign prostatic hyperplasia, and neurogenic bladder), hospital type (university or non-university hospital), and early postoperative rehabilitation status. We defined early postoperative rehabilitation as the start of rehabilitation within 2 days after surgery.[15] Based on this definition, we classified patients as those who received early postoperative rehabilitation (early postoperative rehabilitation group) and those who did not (no early postoperative rehabilitation group). The no early postoperative rehabilitation group did not include patients who were not in rehabilitation. This is because the purpose of this study was to examine differences in the effectiveness of rehabilitation interventions depending on the timing of the intervention for RARP patients.

The DPC database used in this study was accessed independently from the DPC study group to which we belong. However, for ethical reasons, the DPC database is only available to those involved and cannot be accessed by the wider research community.

Statistical Analysis

Multilevel linear regression analysis was conducted with postoperative LOS as the dependent variable, implementation of early postoperative rehabilitation as the independent variable, and each hospital as random effects. We used age, body mass index, T stage classification, CCI, comorbidities, and hospital type as covariates to adjust for potential confounders. All statistical analysis were performed with Stata software (Stata Statistical Software: Release 16; StataCorp LLC, College Station, TX, USA). A P-value of <0.05 was considered statistically significant.

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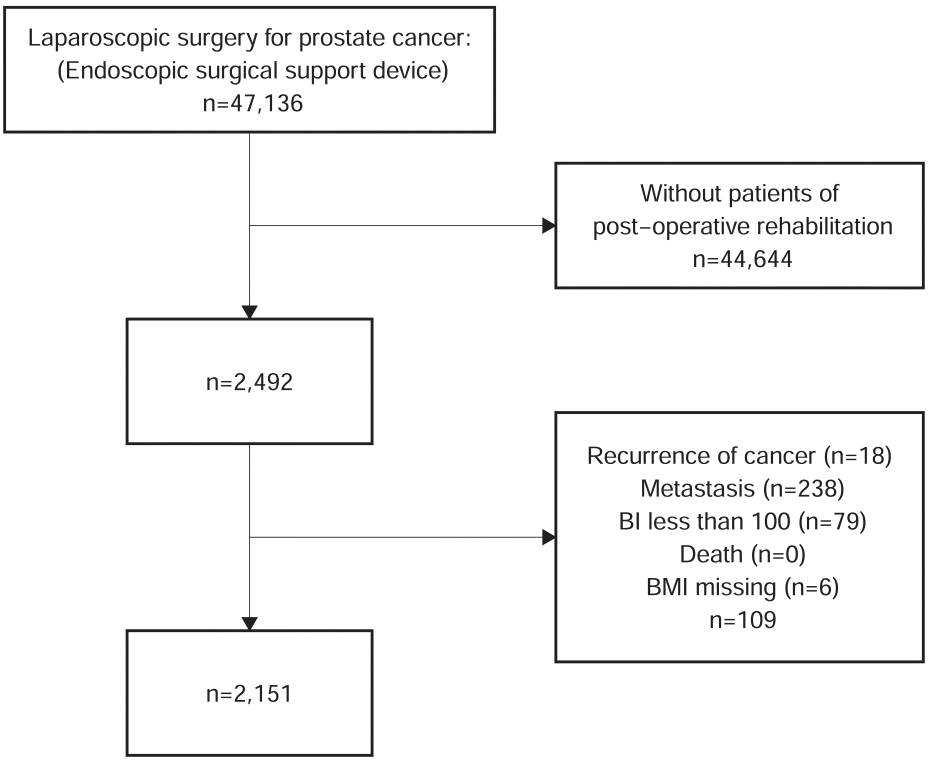

Fig. 1. Patient selection flowchart.

RESULTS

In total, 2151 patients with prostate cancer were included in this study (**Fig. 1**). **Table 1** presents the demographic characteristics of the included patients. Of the 2151 patients, 1168 underwent early postoperative rehabilitation. The mean ages of the early postoperative rehabilitation and no early postoperative rehabilitation groups were similar. The proportion of patients with a CCI of 3 points or greater was higher in the no early postoperative rehabilitation group than in the early postoperative rehabilitation group. In addition, the incidence of comorbid type 2 diabetes was higher in the no early postoperative rehabilitation group than in the early postoperative rehabilitation group. The postoperative LOS was 10.5 [standard deviation (SD) 5.1] days in the early postoperative rehabilitation group and 14.4 (SD 12.2) days in the no early postoperative rehabilitation group.

Table 2 shows the association between early postoperative rehabilitation and postoperative LOS. Univariate analysis showed that early postoperative rehabilitation was not significantly associated with the postoperative LOS [coefficient, −0.78; 95% confidence interval (CI), −1.56 to 0.01; P=0.052]. However, multivariate analysis showed that postoperative rehabilitation was associated with a shorter postoperative LOS (coefficient, −0.86; 95% CI, −1.64 to −0.07; P=0.032).

DISCUSSION

Our study examined the effect of early rehabilitation on LOS in patients with prostate cancer who underwent RARP. The results of this study suggest that early rehabilitation for these patients shortens the postoperative LOS. This may be because of the greater age of the target patients because surgical treatment of elderly patients is associated with an increased risk of postoperative complications and loss of muscle function caused by postoperative bed rest.[16–18]

Most patients with prostate cancer are independent in terms of ADL upon admission; however, it is still assumed that they are suffering from muscle function decline because of aging-related changes. The criteria for considering postoperative rehabilitation are generally poor preoperative physical function and a high risk of complications.[19] Early postoperative rehabilitation for these patients has been reported to improve physical function, prevent postoperative complications, and reduce the hospital LOS.[20–22] Early postoperative rehabilitation has been shown to shorten postoperative LOS in patients undergoing cardiac surgery or lung cancer resection,[12,23] and we believe that similar results were obtained in this study.

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Table 1. Participant characteristics

		Postoperative early rehabilitation	
		No	Yes
		n=983	n=1168
Age (years)		69.2 (6.3)	69.0 (6.0)
Body mass index	<18.5	21 (2.1%)	30 (2.6%)
	18.5≤, <25	621 (63.2%)	732 (62.7%)
	25≤	341 (34.7%)	406 (34.8%)
T stage classification	T0, Tis, and T1	166 (16.9%)	201 (17.2%)
	T2	625 (63.6%)	807 (69.1%)
	T3	155 (15.8%)	156 (13.4%)
	T4	6 (0.6%)	0 (0.0%)
	TX	31 (3.2%)	4 (0.3%)
Charlson Comorbidity Index	0	653 (66.4%)	846 (72.4%)
	1	216 (22.0%)	258 (22.1%)
	2	66 (6.7%)	42 (3.6%)
	≥3	48 (4.9%)	22 (1.9%)
Comorbidity			
Type 2 diabetes mellitus (E11x)		158 (16.1%)	143 (12.2%)
Benign prostatic hyperplasia (N40)		144 (14.6%)	157 (13.4%)
Neurogenic bladder (N31x)		4 (0.4%)	23 (2.0%)
Academic hospital		315 (32.0%)	198 (17.0%)
Postoperative length of stay		14.4 (12.2)	10.5 (5.1)

Data shown as number (percentage) or mean (SD).

One of the characteristics of the DPC data used in this analysis is that the postoperative LOS for patients with prostate cancer was significantly longer than that in previous studies, regardless of whether early rehabilitation was provided.[6–8] Possible causes include differences in insurance systems between Japan and other countries and the fact that eligible patients in Japan are older than those in other countries when they undergo surgery.[24] It has been previously shown that countries with universal health insurance, such as Japan, tend to have longer hospital stays for non-prostate cancer patients.[25] In clinical situations, it is necessary to discuss the indications for early rehabilitation, considering preoperative ADL, physical function, and risk of complications. A model to predict the postoperative LOS has already been reported for bladder cancer,[26] and such models may be effective in identifying patients who require early postoperative rehabilitation. One possible interpretation of the results of this study is that early rehabilitation in patients at high risk of complications after RARP may reduce the incidence of these postoperative complications and therefore reduce the LOS. In addition, early rehabilitation may be indicated where a postoperative decline in ability to perform ADL is predicted; however, because all patients in this study had a preoperative BI of 100, this decline was not expected. Even in the clinical setting, it may be difficult to predict a postoperative decline in ability to perform ADL from the preoperative condition of patients with prostate cancer.

This study had some limitations. First, the number of patients in the database who received rehabilitation after RARP was small because most patients undergoing RARP in Japan are generally hospitalized for around 10 days,[9] and postoperative rehabilitation is not common. Even if rehabilitation were indicated in some cases, the effectiveness of such rehabilitation may remain unclear. In the future, more patients with prostate cancer may be affected by this finding as more physicians prescribe rehabilitation earlier in cases of postoperative complications and postoperative ADL decline. Second, postoperative complications were not included as a confounding factor. Postoperative complications are usually associated with longer hospital stays.[27–29] It is difficult to determine from the database whether rehabilitation was prescribed because of the occurrence or the prevention of postoperative complications. Considering that patients with prostate cancer are usually discharged from the hospital

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Table 2. Multilevel linear regression analysis of factors influencing postoperative length of hospital stay

	Univariate analysis			Multivariate analysis		
	β	95% CI	P	β	95% CI	P
Postoperative early rehabilitation						
No	Reference			Reference		
Yes	−0.78	−1.56 to 0.01	0.052	−0.86	−1.64 to −0.07	0.032
Age	0.03	−0.03 to 0.08	0.303	0.03	−0.03 to 0.08	0.303
Body mass index						
<18.5	Reference				Reference	
18.5≤, <25	−1.76	−3.83 to 0.30	0.095	−1.75	−3.82 to 0.31	0.096
25≤	−1.63	−3.73 to 0.46	0.127	−1.64	−3.74 to 0.46	0.126
T-stage classification						
T0, Tis, and T1	Reference			Reference		
2	−0.50	−1.42 to 0.42	0.288	−0.54	−1.46 to 0.38	0.251
3	−0.30	−1.50 to 0.90	0.621	−0.36	−1.56 to 0.85	0.561
4	−7.44	−13.49 to −1.39	0.016	−7.87	−13.93 to −1.80	0.011
TX	−0.71	−3.59 to 2.17	0.628	−0.75	−3.63 to 2.13	0.608
Charlson Comorbidity Index						
0	Reference			Reference		
1	0.03	−0.78 to 0.85	0.936	−0.07	−1.11 to 0.96	0.892
2	−0.24	−1.76 to 1.28	0.760	−0.41	−2.09 to 1.27	0.631
≥3	0.35	−1.51 to 2.22	0.710	0.37	−1.58 to 2.33	0.708
Type 2 diabetes mellitus (E11x)						
0	Reference			Reference		
1	0.02	−0.90 to 0.94	0.967	0.05	−1.18 to 1.28	0.933
Benign prostatic hyperplasia (N40)						
0	Reference			Reference		
1	0.09	−0.89 to 1.06	0.863	0.07	−0.91 to 1.04	0.895
Neurogenic bladder (N31x)						
0	Reference			Reference		
1	1.55	−2.40 to 5.50	0.441	1.52	−2.42 to 5.46	0.450
Academic hospital						
0	Reference			Reference		
1	2.45	−2.32 to 7.23	0.313	2.33	−2.44 to 7.11	0.338

in around 10 days,[9] it is possible that many of the cases in which rehabilitation was prescribed because of postoperative complications were not those that received early postoperative rehabilitation. Third, our finding that LOS is longer in academic hospitals than in other facilities is inconsistent with the results of previous studies. Previous studies from other countries have found that admission to larger, better-equipped facilities is associated with shorter LOS.[30,31] This may reflect the fact that older patients in Japan experience more complications than those who are younger and are at higher risk for postoperative complications; these cases that are difficult to handle are concentrated in academic hospitals. In fact, a multicenter study conducted at three academic hospitals found that the number of referrals from other hospitals increased after the introduction of RARP.[32,33] Finally, preoperative white blood cell counts have been reported to be predictive of the postoperative LOS in patients with prostate cancer.[7] Whether other preoperative biochemical test results influence the LOS is unknown, and the DPC database does not include these data.

In conclusion, early postoperative rehabilitation may contribute to shorter hospital stays in patients with prostate cancer at high risk of both postoperative complications and a decline in their ability to perform ADL.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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