

Early outcome of the Korean Diagnosis-Related Groups payment system for appendectomy

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Purpose: The implementation of the Korean diagnosis-related groups (DRG) payment system has been recently introduced in selected several diseases including appendectomy in Korea. Here, we report the early outcomes with regard to clinical aspects and medical costs of the Korean DRG system for appendectomies in Seoul Metropolitan Government – Seoul National University Boramae Medical Center throughout comparing before and after introduction of DRG system.

Methods: The DRG system was applied since January 2013 at our institute. After the DRG system, we strategically designed and applied our algorithm for the treatment of probable appendicitis. We reviewed the patients who were treated with a procedure of appendectomy for probable appendicitis between July 2012 and June 2013, divided two groups based on before and after the application of DRG system, and compared clinical outcomes and medical costs.

Results: Total 416 patients were included (204 patients vs. 212 patients in the group before vs. after DRG). Shorter hospital stays (2.98 ± 1.77 days vs. 3.82 ± 1.84 days, $P < 0.001$) were found in the group after DRG. Otherwise, there were no significant differences in the perioperative outcomes and medical costs including costs for first hospitalization and operation, costs for follow-up after discharge, frequency of visits of out-patient's clinic or Emergency Department or rehospitalization.

Conclusion: In the Korean DRG system for appendectomy, there were no significant differences in perioperative outcomes and medical costs, except shorter hospital stay. Further studies should be continued to evaluate the current Korean DRG system for appendectomy and further modifications and supplementations are needed in the future.

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Key Words: Appendicitis, Diagnosis-related groups, Health care costs, Prospective payment system

INTRODUCTION

The diagnosis-related groups (DRG) based payment system was introduced in stages after the beginning of demonstration project at National Health Insurance Service Ilsan Hospital in 2009 and finally, entire hospitals in Korea were required to implement a DRG based payment system for seven groups of specific operations/diseases including appendectomy from July 2013 onwards.

After they were first introduced as a payment system for

medicare in the United States in 1983, a range of DRG-based systems have been implemented worldwide, including many European countries [1]. This kind of payment system is often implemented with the expectation that it will increase the transparency of hospital performance and resource consumption by a standardized reimbursement and will result in greater efficiency by encouraging appropriate care and discouraging unnecessary care [1]. The Korean medical community faced political conflicts with the government after the implementation of the Korean DRG payment system and

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there have been debates on medical cost containment and quality of health care regarding this payment system also.

Therefore the aim of the present study was to compare the clinical outcomes and the medical costs of two groups which had been treated with a procedure of appendectomy, based on before and after application of Korean DRG system. Here, we report the early outcomes with regard to clinical aspects and medical costs of the Korean DRG system for appendectomies during the early 6 months in Seoul Metropolitan Government - Seoul National University Boramae Medical Center.

METHODS

Patient selection

The Korean DRG system was applied since January 2013 at our institute. We retrospectively reviewed the patients who had a primary diagnosis of acute or other appendicitis and underwent a procedure of appendectomy between July 2012 and June 2013. We divided the patients into two groups based on the timing of start of DRG system, in other words, two groups that were operated during each 6 months before and after the implementation of DRG (the group before DRG vs. the group after DRG). The procedure of appendectomy included a simple appendectomy, partial or complete cecectomy and ileocecectomy for probable appendicitis regardless of open or laparoscopic approach. During the selection for the present study, we excluded the patients who underwent combined other operations or were conservatively managed including

percutaneous catheter drainage (PCD) for periappendiceal abscess instead of operation.

This study was approved by the independent ethics committee (Institutional Review Board, IRB) of Seoul Metropolitan Government - Seoul National University Boramae Medical Center (IRB No. 16-2014-28). Informed consent was waived by the IRB.

Surgical procedure

The patients who had been primarily diagnosed with a probable acute or other appendicitis by a surgeon or surgical resident based on abdominal CT scans in adults or ultrasonography in children or pregnant patients underwent an appendectomy, with exception of an appendiceal abscess with more than 4-cm diameter or combined high fever or sepsis (Fig. 1). However, the decision of open or laparoscopic approach was differently done in both groups before and after DRG. The algorithm in Fig. 1 was strategically designed and applied at our institution after the implementation of DRG system as a standard guideline to treat efficiently probable appendicitis and to reduce the probability of open conversion. Before the Korean DRG system, we usually followed a similar approach with that algorithm, but the method of open or laparoscopic procedure was mostly decided after interview and discussion with the patient and/or their family without regard to open conversion.

The patients were placed in the supine position with left tilt and in the Trendelenburg position under general or spinal anesthesia for an open or laparoscopic appendectomy. For the laparoscopic approach, we used three ports (10–12 mm

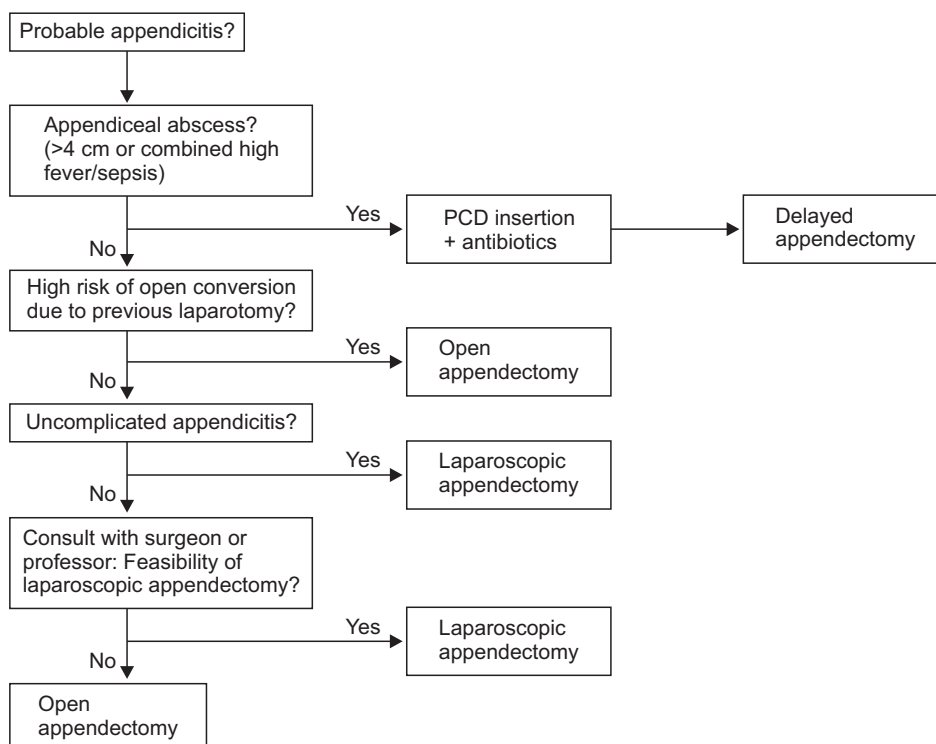


Fig. 1. Algorithm for the treatment of probable appendicitis. PCD, percutaneous catheter drainage.

subumbilical port, 5-mm camera port at left lower quadrant or low midline, 5-mm instrument port at low midline or right lower quadrant), procedures were performed under carbon dioxide pneumoperitoneum and intra-abdominal pressure was electronically maintained below 12 mmHg. A 5 mm in diameter and 30° laparoscope was used. We used hemolock or endoloop to encircle the base of the appendix. The specimen was placed in a plastic bag and extracted through subumbilical port site. For the open approach, we usually used a transverse or an oblique right lower quadrant incision or lower midline incision according to the position or status of appendix. The procedure of appendectomy was done in a usual manner.

In the group after DRG, several costly instruments or drugs were strategically limited, for example, harmonic scalpel or thermofusion device, those were not covered by the Korean DRG system.

Postoperative management and follow-up

Patients were transferred to the general surgical ward or in rare cases to the surgical intensive care unit. Postoperative care was done as usual including perioperative antibiotics prophylaxis, early start of oral feeding within about 8–12 hours after surgery and early mobilization. Laboratory tests were done at postoperative days 1 or 2 and then as clinically needed. Discharge was considered according to the condition of the patient after the achievement of an appropriate diet. Wound care and stitch out was done at out-patient's clinic and, if there was no appendectomy related problem, the follow-up was terminated after stitch out.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics ver. 19.0 (IBM Co., Armonk, NY, USA). Continuous variables were compared with Student t-test and categorical variables were compared using the Pearson chi-square test or the Fisher exact test if the suspected cell frequency was less than 5 or linear by linear association if the variable has more than two categories. All categorical data were expressed as number or frequency with percentage in parenthesis and all continuous data were given as mean \pm standard deviation. All P-values are two-sided and $P < 0.05$ was considered statistically significant.

RESULTS

Baseline characteristics

Between July 2012 and June 2013, 416 patients who underwent a procedure of appendectomy for probable acute or other appendicitis in our institute were included in the present study (204 patients vs. 212 patients in the group before vs. after DRG). Three patients who underwent combined other operations and 15 patients who underwent a conservative management including PCD insertion instead of operation were excluded.

Table 1 summarizes the baseline characteristics of the two groups. Both groups were well balanced for all variables including covariates (age, sex, adult or child, body mass index, route of admission, kind of anesthesia, underlying comorbidity, history of previous laparotomy, using antiplatelet or anticoagulant agents, previous PCD insertion, preoperative laboratory values; white blood cell count, segmented neutrophil,

Table 1. Baseline characteristics

Characteristic	Before DRG (n = 204)	After DRG (n = 212)	P-value
Age (yr)	36.72 \pm 19.07	34.27 \pm 18.29	0.183
Sex			0.582
Male	119 (58.3)	118 (55.7)	
Female	85 (41.7)	94 (44.3)	
Adult: child			0.156
Adult	176 (86.3)	172 (81.1)	
Child (<16 yr)	28 (13.7)	40 (18.9)	
Body mass index (kg/m ²)	22.79 \pm 3.64	22.39 \pm 3.77	0.273
Admission via Emergency Department	192 (94.1)	204 (96.2)	0.249
General anesthesia	199 (97.5)	210 (99.1)	0.232
Comorbidity	45 (22.1)	40 (18.9)	0.420
Previous laparotomy	13 (6.4)	16 (7.5)	0.514
Previous antiplatelet/anticoagulant	13 (6.4)	10 (4.8)	0.481
Previous PCD insertion	4 (2.0)	3 (1.4)	0.720
Preoperative laboratory values			
White blood cell ($\times 10^3/\mu\text{L}$)	12,529 \pm 4,364	13,314 \pm 4,246	0.070
Segmented neutrophil (%)	78.26 \pm 11.50	78.56 \pm 11.65	0.799
C-reactive protein (mg/dL)	4.70 \pm 7.20	3.45 \pm 5.29	0.053

Values are presented as mean \pm standard deviation or number (%). DRG, diagnosis-related groups; PCD, percutaneous catheter drainage.

C-reactive protein), and there was no significant difference between both groups.

Operation and operative findings

Table 2 shows the operations and operative findings by group without significant differences. Open conversion tended to be greater in the group before DRG (5.4% vs. 1.9% in the group after DRG, $P = 0.055$). However, the other data including simple appendectomy (95.6% vs. 97.6%, $P = 0.286$), laparoscopic procedure (87.3% vs. 91.5%, $P = 0.158$), perforated appendix (15.3% vs. 19.9%, $P = 0.216$), involvement of cecal base (5.9% vs. 6.6%, $P = 0.762$), periappendiceal abscess (7.4% vs. 11.4%, $P = 0.170$), degree of appendiceal inflammation (gangrenous, 11.4% vs. 15.8%, $P = 0.306$), drain insertion (26.6% vs. 27.8%, $P = 0.779$),

and operative time (70.67 ± 33.66 minute vs. 66.86 ± 35.81 minute, $P = 0.266$) were similar between both groups.

Comparison of postoperative outcomes and medical costs

Table 3 summarizes postoperative outcomes and medical costs. Of 212 patients in the group after DRG, 98.6% were for DRG system ($n = 209$).

In the group before DRG, the length of hospital stay was significantly longer than in the group after DRG (3.82 ± 1.84 days vs. 2.98 ± 1.77 days, $P < 0.001$). However, there were no significant differences in variables related with postoperative outcomes including the overall complication rate (7.8% vs. 4.2%, $P = 0.123$), postoperative wound complication (including

Table 2. Operation and operative findings

Variable	Before DRG (n = 204)	After DRG (n = 212)	P-value
Operation			0.286
Simple appendectomy	195 (95.6)	207 (97.6)	
Extended appendectomy ^{a)}	9 (4.4)	5 (2.4)	
Laparoscopic procedure	178 (87.3)	194 (91.5)	0.158
Open conversion	11 (5.4)	4 (1.9)	0.055
Operative findings			
Perforated appendix	31 (15.3)	42 (19.9)	0.216
Involvement of cecal base	12 (5.9)	14 (6.6)	0.762
Periappendiceal abscess	15 (7.4)	24 (11.4)	0.170
Inflammation			0.306
Hyperemia	92/201 (45.8)	90/209 (43.1)	
Suppurative	86/201 (42.8)	86/209 (41.1)	
Gangrenous	23/201 (11.4)	33/209 (15.8)	
Drain	54 (26.5)	59 (27.8)	0.779
Operative time (min)	70.67 ± 33.66	66.86 ± 35.81	0.266

Values are presented as number (%) or mean \pm standard deviation.

DRG, diagnosis-related groups.

^{a)}Partial or complete cecectomy, ileocecectomy accompanying appendectomy.

Table 3. Comparison of postoperative outcomes and medical costs

Variable	Before DRG (n = 204)	After DRG (n = 212)	P-value
Application of DRG	0 (0)	209 (98.6)	<0.001
Hospital stay (day)	3.82 ± 1.84	2.98 ± 1.77	<0.001
Overall complication rate ^{a)}	16 (7.8)	9 (4.2)	0.123
Wound problem	11 (5.5)	6 (2.9)	0.183
Ileus	2 (1.0)	1 (0.5)	0.617
Intraabdominal abscess	2 (1.0)	1 (0.5)	0.617
No. of visits of out-patient's clinic or ED after discharge	1.69 ± 2.03	1.58 ± 1.36	0.508
Rehospitalization	1 (0.5)	2 (1.0)	>0.999
Medical costs (KRW)			
During first hospitalization	$2,479,245 \pm 584,922$	$2,541,006 \pm 518,506$	0.256
After first discharge until end of follow-up	$51,638 \pm 114,949$	$48,270 \pm 131,387$	0.781
Total amount	$2,529,409 \pm 596,188$	$2,589,276 \pm 542,224$	0.284

Values are presented as number (%) or mean \pm standard deviation.

DRG, diagnosis-related groups; ED, Emergency Department; KRW, Korean won (the currency of South Korea).

^{a)}Early complication within 1 month after operation.

subcutaneous seroma) (5.5% vs. 2.9%, $P = 0.183$), ileus (1.0% vs. 0.5%, $P = 0.617$), intraabdominal abscess (1.0% vs. 0.5%, $P = 0.617$), number of visits of out-patient's clinic or Emergency Department after discharge (1.69 ± 2.03 vs. 1.58 ± 1.36 , $P = 0.508$), rehospitalization related with previous appendectomy (0.5% vs. 1.0%, $P = 1.000$) between both groups. No mortality was shown in either group.

In the aspect of medical costs, there were no significant differences between both groups including medical costs during first hospitalization of that appendectomy was performed ($2,479,245 \pm 584,922$ Korean Won [KRW] vs. $2,541,006 \pm 518,506$ KRW, $P = 0.256$), costs after first discharge until end of follow-up ($51,638 \pm 114,949$ KRW vs. $48,270 \pm 131,387$ KRW, $P = 0.781$) and the total medical costs related with appendectomy ($2,529,409 \pm 596,188$ KRW vs. $2,589,276 \pm 542,224$ KRW, $P = 0.284$).

DISCUSSION

The most frequent reasons to introduce the DRG systems are to increase efficiency and contain the medical costs [2]. The Korean DRG payment system has recently introduced amid considerable controversy in selected several operations/diseases including appendectomy in Korea. Recently, Yoo et al. [3] reported their results about effectiveness of the current Korean DRG system in laparoscopic appendectomy and tried to determine the factors that influence the amount of the DRG reimbursement and total in-patient cost. However, a few studies have been conducted about Korean DRG system for appendectomy for now. Therefore, we designed to evaluate the compared results about clinical outcomes in appendectomy before and after the application of the Korean DRG system and to investigate its cost-effectiveness.

Even if the case-controlled study was retrospectively performed at a single institution, it was well-balanced and showed that there were no significant differences in clinical outcomes, except hospital stay, and in medical costs before and after Korean DRG system for appendectomy. Contrary to expectations, number of visits at out-patient's clinic or Emergency Department and rehospitalization did not increase after implementation of DRG system in the present study. After all, there was no cost-reducing effect of Korean DRG system for appendectomies in our institution even though shorter length of hospital stays were shown (3.82 ± 1.84 days vs. 2.98 ± 1.77 days, $P < 0.001$).

DRG-based payments incentivize hospitals to cut down on costs per patient, for example, by reducing the length of hospital stay or the intensity of services [4]. These behavioral responses may be intended (e.g., a reduction of resource intensity via the introduction of efficient clinical pathways) but may also take unintended forms such as inappropriate early

discharge, skimping, or dumping [4-6]. For the avoidance of these unintended consequences, the DRG needs to be defined resource homogenously to ensure that DRG-based payments reflect treatment costs as precisely as possible for a given patient [4]. We introduced a specific algorithm for the treatment of a probable appendicitis and efficient clinical pathways for perioperative management to standardize and to maintain efficacy after the implementation of the Korean DRG system for appendectomy in our institution (Fig. 1). These kinds of efforts for standardized and efficient protocol in Korean DRG system are needed, and there should be wider discussion to actualize the intent of the Korean DRG system.

For a prompt diagnosis, we performed an abdominal CT scan in all adults and ultrasonography in children or pregnant patients. Most patients diagnosed with appendicitis had acute appendicitis (98.8% in other study) [7] and were admitted via Emergency Department as shown in Table 1 (94.1% and 96.2%). Therefore, quick and accurate diagnosis is very important in patients of suspicious appendicitis. For such reasons, CT scans to diagnose appendicitis has been generalized in clinical situations, especially in hospitals including our institute, even though the current Korean DRG system does not provide any economic reward for CT scans. Therefore, a proper reward for the use of CT scan should be concerned through the revised Korean DRG system in the future.

In early phase of the implementation of the Korean DRG system, we need to address and discuss about the pros and cons of the current Korean DRG system for respective items including appendectomy. Even though we did not deal with variables for case of classifications of the DRG system in the present study, this is another important issue and we have to pay attention to this point for the further supplementation in the Korean DRG system including appendectomy.

The use of the DRG system requires sufficiently homogenous groups of patients in terms of treatment costs. Otherwise, performance comparisons on the basis of DRG system do not adequately control regarding the differences of patients within different groups and the reimbursement for a large number of patients is not appropriate. In order to assure homogenous groups of patients, the DRG system needs to consider the most important determinants of resource consumption as classification variables [8]. Hospitals may avoid the treatment of high-cost patients if the patient's classification system of DRG fails to distinguish major factors influencing patient's costs [9,10]. Quentin et al. [8] performed a multicenter study about DRG for appendectomy, especially regarding the patient classification and hospital reimbursement of DRG in 11 European countries. They insisted that surgeons and national DRG authorities should consider how other countries' DRG systems classify appendectomy patients in order to optimize their DRG system and to ensure fair and appropriate

reimbursement. Actually, countries use different numbers of variables to classify appendectomy patients, ranging from 2 (Poland and Sweden) to 8 (Germany) [9].

In Korean DRG system for appendectomy, two kinds of classification of DRG system with one variable (perforation of appendix) are used: simple appendicitis and perforated appendicitis. Hospitals and surgeons treating a greater share of more complex cases than others are not adequately paid for their greater efforts if the DRG systems do not adequately account for differences between patients [8]. We need more discussions and larger-scale multicenter studies about this current classification of the Korean DRG for appendectomy, considering other possible important variables; age, laparoscopic vs. open approach, comorbidities or underlying diseases, post-operative complications.

Age can be one of the important variables of classification for the DRG system. The prevalence of perforated appendicitis by age has a U-shaped pattern; prevalence was highest in children younger than five years and in adults older than 60 years [11]. Although not always significant, it appears to be a U-shaped relationship between age and length of hospital stay, with younger (<11) and older (>35) age groups tending to have longer stays [9]. The relationship between cost and age is less clear, although patients aged between 16 and 35 years tend to have lower costs [9]. Postoperative complications and medical costs for appendectomy are supposed to be higher than in others in the younger and elder populations. Therefore, hospitals generally receive higher payments for elderly patients and for children in DRG systems where age is considered in the classification process [8].

Laparoscopic approach or open approach can be another variable in the classification of the DRG system for appendectomy. Although associated with shorter stays compared to open appendectomy, laparoscopic approach is more frequently linked with significantly higher costs in other studies

[12-14]. However, in another studies, these higher costs may be justifiable, as laparoscopy is associated with lower rates of wound infection [9,15,16]. In Korea, laparoscopic appendectomies have comprised a considerable and increasing portion in the total number of appendectomies (about 90% in our study, Table 2). Therefore this could be one of the important variables in the classification and more studies are needed.

The present study had some limitations despite being a well-balanced comparative study. There are three grades of medical institutions from a clinic to university hospital in the Korean DRG system. However, the present study was a retrospective study at a single institution. Additionally, this study was performed at an early stage and in a relatively short-term period before and after implementation of the Korean DRG system for appendectomy. Therefore, we cannot certainly guarantee that there was no possibility of selection bias. Nevertheless, we believe that the present study could serve as a useful background research for future larger-scale, multicenter studies and for studies after a well-established DRG system for appendectomy.

In conclusion, although limited by a single center study, there were no significant differences, except, length of hospital stay in the early outcomes with regard to clinical aspects and medical costs of the Korean DRG system for appendectomies throughout comparing before with after introduction of Korean DRG system. Further studies should be continued to evaluate and improve the current DRG payment system for appendectomy and further modifications and supplementations are needed in the future.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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