Perioperative Medication Withholding in Patients with Parkinson's Disease:

A Retrospective Electronic Health Records Review

The authors explore medication withholding times and symptom management.

Parkinson's disease is a progressive neurodegenerative disorder of the dopaminergic motor pathways. The four main motor symptoms are bradykinesia, rigidity of the limbs or trunk, involuntary tremor, and postural instability.[1] Other symptoms can include a range of cognitive changes (including attention and memory deficits, personality changes, and hallucinations), mood disorders (including depression, anxiety, and irritability), loss of facial expression, and diminished automatic reflexes. Symptom management is heavily dependent on patients receiving their antiparkinson medications at the appropriate dosages and timing, which in turn is dependent on other variables (see Figure 1). Since surgery and hospitalization can disrupt medication regimens, it's important to minimize such disruptions to promote optimal symptom management.

According to the National Parkinson Foundation, the disease affects between 1 and 1.5 million people in the United States and 4 to 6 million people worldwide.[2] Approximately 50,000 to 60,000 new cases are diagnosed annually in this country[3]; the average age of diagnosis is 60 years.[2] As is true of the general population, people with Parkinson's disease are living longer, and health care professionals are seeing more such patients for other health care needs. Indeed, with advances in surgical techniques and medical treatments, more elderly patients, including those with Parkinson's disease, are presenting for surgical procedures.[4] To provide the safest, highest-quality perioperative care to patients with Parkinson's disease, all health care providers must be cognizant of the pathophysiology, clinical symptoms, medications, and potential complications unique to this population.

In this first of two articles, we report on findings from a quantitative study exploring antiparkinson medication withholding times during hospitalization and symptom management. The second article will report on findings from a qualitative study of patients with Parkinson's disease that focused on their hospitalization experiences, particularly with medication withholding.

BACKGROUND AND OBJECTIVES

In a systematic review of the literature on emergency and hospital admissions of patients with Parkinson's disease, Gerlach and colleagues cited 89 articles, including 15 on studies investigating perioperative clinical problems experienced by such patients.[5] Of

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ABSTRACT

Background: Carbidopa-levodopa (Sinemet), the gold-standard treatment for Parkinson's disease, has a short half-life of one to two hours. When patients with Parkinson's disease are placed on NPO (*nil per os*, or nothing by mouth) status for surgery, they may miss several doses of carbidopa-levodopa, possibly resulting in exacerbation of Parkinson's disease symptoms. Clear guidelines regarding perioperative symptom management are lacking.

Objectives: The goals of this study were threefold: to measure the perioperative duration of the withholding of carbidopa-levodopa in patients with Parkinson's disease, to record the time of day surgeries were performed on these patients, and to record perioperative exacerbations of Parkinson's disease symptoms.

Methods: We conducted a retrospective review of patient electronic health records at a Midwestern public medical center. After applying inclusion and exclusion criteria and evaluating the eligible records, we had a final sample of 89 separate surgical events for 67 discrete patients who had been diagnosed with Parkinson's disease, had undergone any type of surgery excepting Parkinson's disease surgeries, and were taking carbidopa-levodopa.

Results: The median duration of carbidopa-levodopa withholding was 12.35 hours, with most surgical procedures (86%) starting at 9 AM or later. The most commonly reported exacerbation of Parkinson's disease symptoms was agitation or confusion.

Conclusions: For best symptom management, careful consideration should be given to scheduling surgery at the earliest possible time, administering medications as close to the patient's usual dosing schedule as possible, and providing nursing education about optimal medication management for this patient population.

Keywords: anesthesia, carbidopa-levodopa, medication management, Parkinson's disease, perioperative complications, symptom management

these 89 articles, some provided background information, while others documented problems with antiparkinson medications during hospitalization and surgery, symptom management, and efforts to improve care. Only four were published in nursing journals: two in a journal specializing in postanesthesia care nursing,[6, 7] one in a journal for nurse anesthetists,[8] and one in a journal on orthopedic nursing.[9] None of the studies cited in the tables or text attempted to quantify the duration of medication withholding in a sample of patients with Parkinson's disease undergoing surgery or anesthesia. Our study begins to address that gap in the nursing literature.

A primary goal of treatment for Parkinson's disease is symptom management that helps patients to function at the highest possible level in activities of daily living. The gold-standard treatment for Parkinson's disease is the combination drug carbidopa-levodopa (Sinemet). Levodopa is a prodrug that, after crossing the blood–brain barrier, is converted to dopamine, the neurotransmitter made deficient by this disease. Carbidopa acts to inhibit the peripheral conversion of levodopa to dopamine, thus making more of the drug available to the brain and reducing peripheral dopamine adverse effects, such as nausea.[10, 11]

One concern with carbidopa-levodopa is its short, one-to-two-hour half-life, requiring dosing several times per day. Moreover, because of wide variability in patients' responses to this and other antiparkinson medications (such as dopamine agonists and catechol-*O*-methyltransferase inhibitors), individual regimens may be quite complex. Some regimens require frequent administration, alternating short-acting and sustained-release doses of carbidopa-levodopa.[10, 11] The complex medication regimens are of particular concern when a patient with Parkinson's disease must remain on NPO (*nil per os*, or nothing by mouth) status for several hours perioperatively.[5, 12, 13] Although there has been some research investigating perioperative medication management and complications of medication withholding in Parkinson's disease patients,[4, 14, 15] no clear guidelines have been developed for the perioperative nursing care of these patients.

To address that need, we conducted a retrospective review of patient electronic health records (EHRs) at a Midwestern public medical center. The goals were threefold: to measure the perioperative duration of the withholding of carbidopa-levodopa, to record the time of day surgeries were performed on patients with Parkinson's disease, and to record perioperative exacerbations of Parkinson's disease symptoms. For

Figure 1. Variables and Their Effects on the Optimal Timing of Carbidopa-Levodopa Delivery and Parkinson's Disease Symptom Management During Hospitalization
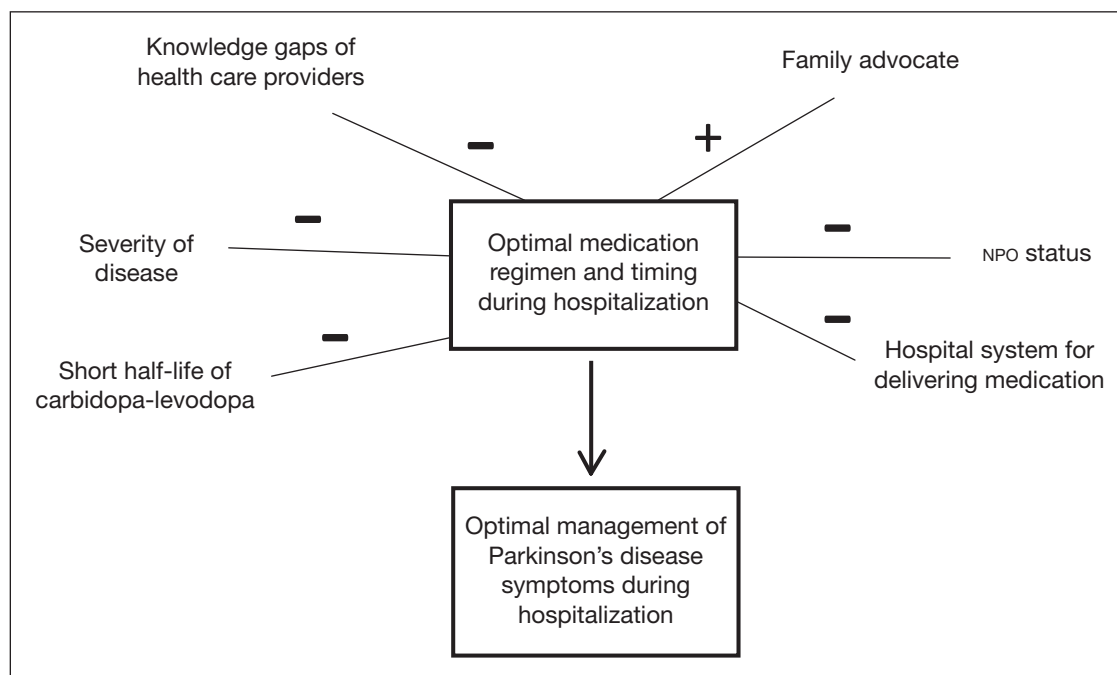
the purposes of this descriptive study, the perioperative period was defined as from midnight prior to surgery until the time of postoperative discharge from the hospital.

METHODS

Sample. Approval for the study was obtained from the institutional review board committees of the participating medical center and university. Waivers of informed consent and authorization were granted by both institutions. All data collected were de-identified, secured, and accessible only to the investigators.

The population of interest was patients with a diagnosis of Parkinson's disease who'd had any type of surgery, excepting Parkinson's disease surgeries (such as deep brain stimulation surgery). A purposive sample of surgical cases (N = 89) from June 9, 2004, through May 1, 2006, was derived from patient EHRs from the medical center, where one of the study investigators (KF) worked as a nurse anesthetist. In the medical center, which has 197 inpatient beds, approximately 8,000 surgeries are performed per year.

Sample selection strategy. A data management expert employed by the medical center generated a password-protected list of 746 surgical procedure records that the investigators could assess for eligibility. This list was generated via a computer search that cross-referenced International Classification of Diseases, Ninth Revision (ICD-9) codes for parkinsonian-type diagnoses with Current Procedural Terminology

(CPT) codes for surgical procedures performed from January 1, 2001, through May 1, 2006. Each surgical event was then assigned an identification number and sorted from most-to-least-recently performed.

We then started reviewing the pool of 746 EHRs, beginning with the most recent. A total of 166 EHRs were assessed for eligibility; at that point, the review process was stopped because of resource constraints. Inclusion criteria were a diagnosis of Parkinson's disease and treatment with carbidopa-levodopa. Exclusion criteria were surgical procedures that didn't require NPO status, surgical procedures that were performed as part of treatment for Parkinson's disease, and an EHR with insufficient data. All EHR data were collected from computer terminals within the hospital.

Some patients appeared on the procedure list several times because they'd had multiple procedures during the same surgery case on the same day. In such instances, the multiple procedures were recorded as one surgical event, since all other factors such as the patient, the duration of medication withholding, and the possible complications were the same. On the other hand, some patients appeared on the procedure list several times because they'd had multiple surgeries during the data collection period but on different days. In those instances, each surgical event was recorded as a separate event, but we made note of the fact that this subset of patients had had several surgical procedures on different days.

Eighty-nine EHRs, dated between June 2004 and May 2006 and involving 67 discrete patients, met the inclusion criteria.

Outcome measures. The primary measure, the duration of withholding of carbidopa-levodopa, was defined as the length of time a patient with Parkinson's disease was without this medication during the perioperative period. (Some patients were also on other antiparkinson medications, but we tracked only carbidopa-levodopa withholding.) For inpatients, this was calculated as the difference between the time of the last recorded preoperative dose and the first recorded postoperative dose. If the time of the last preoperative dose was unknown because it wasn't listed in the patient's EHR, a time of midnight was assumed, because at this medical center patients are typically placed on NPO status after midnight for surgical procedures occurring the next day. If the patient's EHR indicated "AM meds," a preoperative dosing time of 6 AM was assumed. Although it's possible that antiparkinson medications weren't actually given with "AM meds," we chose the more conservative time point so as not to overestimate the duration of medication withholding. The first postoperative dose was found in patients' EHRs.

Other measures were recorded to further characterize this patient population. These included the surgical procedure, the surgical end time, the year of surgery, comorbidities, the pre- and postoperative regimen for carbidopa-levodopa, and all other drugs and dosages given during surgery and the postoperative period.

Data collection. The data collection tool used for this retrospective study was designed by the principal investigator (KF). The principal investigator and coinvestigator (LCA) tested the tool using two EHRs and made minor revisions. The tool was organized for consistency with EHR sections used by the medical center. Admission databases and patient history and physical examination sections were used to collect demographic data, evidence of a confirmed diagnosis of Parkinson's disease, and comorbidity data. Anesthesia records were used to determine the type of surgery performed, surgery times, and perioperative medications. Nursing, neurology consult, and progress notes were used to record information about disease severity, symptoms, and symptom exacerbations that were possibly related to the surgery. Medication records were used to find antiparkinson medications, regimens, and times of pre- and postoperative medication dosing.

In this study, the median duration of withholding of carbidopa-levodopa for patients whose surgical procedures required them to be on NPO status was approximately 12.5 hours for the entire sample.

For outpatients, the duration of medication withholding was calculated as the difference between the time of the last recorded preoperative dose and the discharge time. The discharge time was used instead of the first postoperative dose because the latter often wasn't listed in the EHR. We chose the discharge time as a more conservative time point so as not to overestimate the duration of medication withholding.
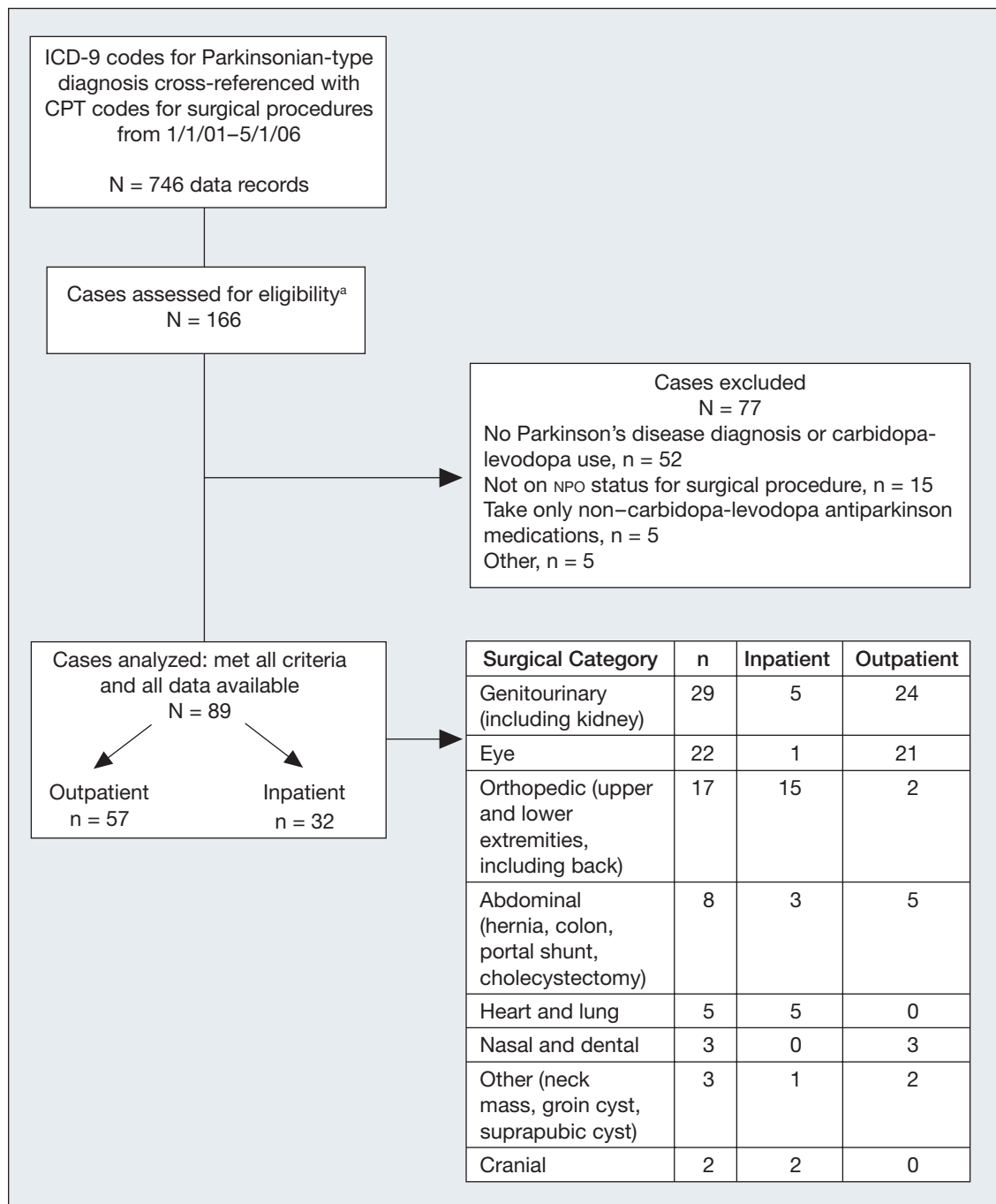
The second outcome measure was the surgical start time. This was extracted from the electronic intraoperative report or anesthesia record.

The third outcome measure was perioperative exacerbation of Parkinson's disease symptoms. Because the study was descriptive, instead of using a specific checklist, the data abstractors recorded qualitative data from the patient's record. Notations about Parkinson's disease symptom management related to the current hospitalization were recorded from nursing and progress notes. Notations about symptom management from perioperative nursing and progress notes for the sampled surgical event were also recorded. Examples of exacerbated symptoms were hallucinations, agitation, and extreme rigidity.

Four data abstractors collected the study data: the principal investigator, the coinvestigator, and two nursing anesthesia graduate students who had been educated on the use of the tool. All study personnel received training from the medical center on data privacy and the EHR. Each data abstractor also completed several online modules in the use and protection of private health information and attended a four-hour class on the EHR management program used by the medical center. To enhance the consistency of data collection among the abstractors, the first 10 EHRs were reviewed by all four abstractors, who then discussed the data collection process and reviewed the tool. Although there was no formal assessment of interrater reliability, discussion of the first 10 EHRs revealed no apparent differences among the abstractors in the coding.

For the rest of the data abstraction process, one of the four data abstractors would choose a patient having a procedure or group of procedures from the top of the list and search for the patient's EHR. The abstractor would then determine whether the patient met inclusion or exclusion criteria. If the patient was

Figure 2. Flowchart of Patients, Eligibility, and Analysis

ICD-9 codes for Parkinsonian-type diagnosis cross-referenced with CPT codes for surgical procedures from 1/1/01–5/1/06 N = 746 data records

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Cases assessed for eligibility[a] N = 166

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Cases excluded N = 77 No Parkinson's disease diagnosis or carbidopa-levodopa use, n = 52 Not on NPO status for surgical procedure, n = 15 Take only non–carbidopa-levodopa antiparkinson medications, n = 5 Other, n = 5

Cases analyzed: met all criteria and all data available N = 89 Outpatient   Inpatient n = 57   n = 32

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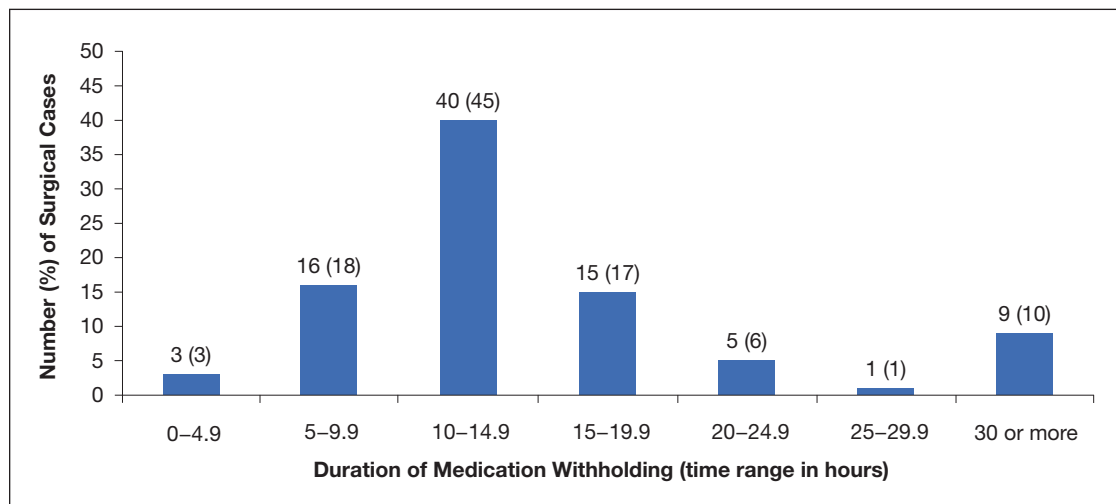| Surgical Category	n	Inpatient	Outpatient
Genitourinary (including kidney)	29	5	24
Eye	22	1	21
Orthopedic (upper and lower extremities, including back)	17	15	2
Abdominal (hernia, colon, portal shunt, cholecystectomy)	8	3	5
Heart and lung	5	5	0
Nasal and dental	3	0	3
Other (neck mass, groin cyst, suprapubic cyst)	3	1	2
Cranial	2	2	0

CPT = Current Procedural Terminology; ICD-9 = International Classification of Diseases, Ninth Revision.
[a]Multiple procedures during same operating room admission counted as one case.

excluded, a notation was made on the spreadsheet and the abstractor took the next patient on the list. For included patients, the de-identified data abstracted from the EHR included demographic information (age, sex, population of the patient's city of residence, race or ethnicity); the surgical procedure performed; the start and end times of surgery; the year of surgery; comorbidities; Parkinson's disease symptoms and exacerbations referenced in nursing, neurology consult, or progress notes; the pre- and postoperative regimen for all Parkinson's disease–related medications; all other drugs and dosages administered to the patient during

Figure 3. Surgical Cases and Duration of Medication Withholding[a]

the entire perioperative period as defined earlier; and whether the surgical procedure was an inpatient or outpatient procedure.

All collected de-identified data were entered into IBM SPSS Statistics version 16 by a third nursing anesthesia graduate student who did not work on the data abstraction. Data were validated and checked for outliers and completeness. Logical inconsistencies and outliers were cross-checked against the paper data collection forms, and corrections were made as necessary.

Data analysis. For all analytic results, the reporting base (89 separate surgical events or 67 discrete patients) is indicated. Descriptive statistics (median/range or mean/standard deviation) were calculated for the duration of medication withholding and patient age. Duration of medication withholding was calculated for the entire sample, inpatient procedures, and outpatient procedures. Surgical start times were grouped as follows: early morning start times (6 AM to 8:59 AM), late morning start times (9 AM to 11:59 AM), and afternoon or evening start times (noon to midnight). The frequency of surgical procedures for each time frame was determined for the entire sample, inpatient procedures, and outpatient procedures.

Categorical variables such as the type of surgery performed and comorbidities were organized in frequency tables. On the data collection tool, comorbidities were grouped into eight categories: respiratory, cardiovascular, endocrine, renal, gastrointestinal, hepatic, neurologic–non-Parkinson's disease, and other. Based on the frequency of various comorbidities listed under "other," two more categories were added: eye, and bone and joint. The renal category was renamed genitourinary so that comorbidities such as bladder and prostate disorders could be

included in the group (as they often are in the literature).

On the data collection tool, the type of surgery performed was recorded based on the CPT code. Because CPT codes are very specific and several can represent a group of similar surgical procedures, surgical procedures were grouped into commonly used descriptive categories: genitourinary, eye, orthopedic, abdominal, heart and lung, nasal and dental, cranial, and other.

The nursing and progress notes of all inpatients were analyzed for entries that indicated a possible perioperative exacerbation of Parkinson's disease symptoms. Outpatient EHRs were not analyzed because record keeping for outpatient surgeries at the medical center is abbreviated, and entries into the nursing and progress notes typically aren't made. Initially the inpatient notes were read so that investigators could get a sense of the content as a whole. After further analysis, all notations referencing Parkinson's disease symptoms were grouped into four categories (described further in the Results section).

RESULTS

Characteristics of the patient sample. The study sample consisted of 89 separate surgical events performed on 67 patients, with 51 patients having one surgery and 16 patients having more than one surgery. The data abstractors began systematically with the most recent surgery in the data set and worked backward, starting with May 2006 and ending with June 2004. Demographically, the 67 patients were primarily male (n = 65, 97%), white (n = 52, 78%), and non-Hispanic/Latino (n = 56, 84%). Mean age was 75 ± 9 years. A majority of patients came from the seven-county metropolitan area where the study medical center is located. Sampled surgeries occurred

between June 2004 and May 2006, and 57 (64%) of the procedures were outpatient. For more demographic data, see Table 1.

The most commonly performed surgical procedures by category were genitourinary (33%), eye (25%), and orthopedic (19%). For a flowchart showing patient assessment for eligibility and case analysis, as well as a summary of surgical procedures by category, see Figure 2.

The most common comorbidity category was cardiovascular, with 139 comorbidities identified among the 89 surgical events. The next most common category was neurologic–non-Parkinson's disease (n = 77), followed by genitourinary (n = 49), gastrointestinal (n = 42), endocrine (n = 36), respiratory (n = 27), eye (n = 18), bone and joint (n = 7), hepatic (n = 3), and other (n = 10). The most common individual comorbidity was hypertension, which was identified in 53 (60%) of the 89 surgical events. The next most common individual comorbidity was gastroesophageal reflux disease (33%), followed by coronary artery disease (31%), diabetes (26%), and depression and eye

comorbidities (20% each). The individual comorbidities were many and varied (408 were identified within the study sample). This is similar to what has been described by other authors.[16, 17] The average number of comorbidities per surgical event in this study was 4.6. For a summary of the categorized and individual comorbidities recorded for the sample of 89 surgical events, see Table 2 at http://links.lww.com/AJN/A44. Comorbidities are reported by surgical event because an individual patient might not have the same comorbidities for surgeries occurring in different years.

Medication withholding. The data for withholding of carbidopa-levodopa were not normally distributed. The median time of medication withholding for the 89 surgical events was 12.35 hours (range, 4.35 to 143.05 hours). For inpatient procedures (n = 32), the median withholding time was 16.75 hours (range, 6 to 143.05 hours); for outpatient procedures (n = 57), the median withholding time was 11.38 hours (range, 4.35 to 20.59 hours). As shown in Figure 3, 62% of the surgeries (n = 55) resulted in medication withholding times of between 10 and 20 hours, and 17% of the surgeries (n = 15) resulted in withholding times of 20 or more hours (with more than half of these [n = 9] resulting in withholding times of 30 or more hours).

Surgical start times. The surgical start time for one case was missing, so data analysis for this measure was performed on 88 surgical cases. The mean surgical start times for the entire sample and for only the outpatient procedures were similarly early (11:53 AM [± 2:58] and 11:35 AM [± 2:21], respectively), while the mean surgical start time for the inpatient procedures was later (12:25 PM [± 3:48]). As shown in Figure 4, the majority of the surgical procedures (76 of 88) started after 9 AM, with almost half (41 of 88) starting between 9 AM and 12 PM. Only 12 of 88 procedures started between 6 and 9 AM.

Perioperative exacerbations of Parkinson's disease symptoms. In the study medical center, outpatient nursing notes are minimal and patients are discharged very quickly after surgery, before possible symptom exacerbations would develop. Thus, only inpatient EHRs were reviewed for notations about Parkinson's disease symptom exacerbations. Of the 32 inpatient EHRs analyzed, 18 (56%) contained a nursing or progress note referencing Parkinson's disease symptoms or symptom management. The 26 notations were reviewed for commonalities and fell into four broad categories: increased agitation, confusion, or both (n = 10); antiparkinson medications received inconsistently or not at all (n = 8); increased tremors, shakiness, or both (n = 5); and symptom management complicated by pain, pain medications, or both (n = 3).

Four of the EHRs were particularly informative. In record 1, it was noted that the patient remained on NPO status and without antiparkinson medication (carbidopa-levodopa) until postoperative day 5. Over

Table 1. Demographic Data (N = 67)

	n (%)
Hospitalization status[a]	
Inpatient	32 (36)
Outpatient	57 (64)
Sex	
Male	65 (97)
Female	2 (3)
Race	
American Indian/Alaska Native	1 (1)
White	52 (78)
Unspecified	14 (21)
Ethnicity	
Hispanic/Latino	1 (1)
Not Hispanic/Latino	56 (84)
Unspecified	10 (15)
Population of city of residence	
Less than 20,000	30 (45)
20,000 or more	37 (55)
City or suburban	
City	35 (52)
Suburban	32 (48)
Year of surgery[a, b]	
2004	2 (2)
2005	60 (67)
2006	27 (30)

[a] Based on 89 surgical events.
[b] Because of rounding, percentages might not sum to 100.

Figure 4. Frequency of Surgical Cases Grouped by Surgical Start Time[a]
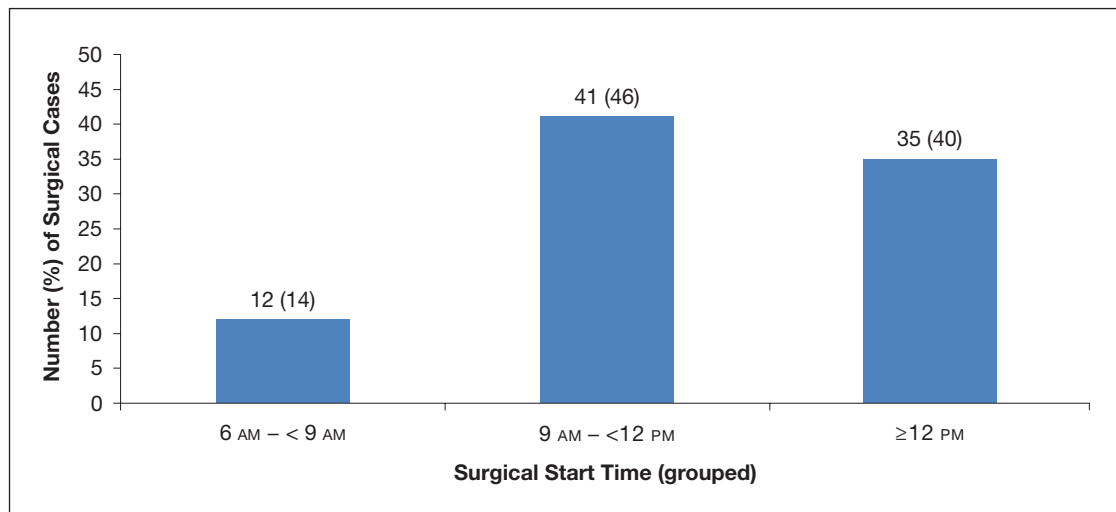
ª Based on 88 surgical events.

those five days, the patient became stiff, shaky, rigid, and unable to eat or speak. Restraints were recommended. In record 2, the notes indicated that the patient, who was in the ICU, remained without his antiparkinson medication (carbidopa-levodopa) until postoperative day 3. He gradually became more agitated, disoriented, and confused. When he reported hallucinations, a psychiatric consult was requested and antipsychotic medication was ordered. He also received the contraindicated medication promethazine for nausea. Only after he was transferred out of the ICU to a surgical ward did this patient begin receiving his antiparkinson medication. In record 3, the notes indicated that a patient who had surgery for a gastric volvulus did not receive his antiparkinson medication (carbidopa-levodopa) for 17 days after surgery. He became catatonic. Lastly, record 4 indicated that the patient received excellent care concerning his antiparkinson medications (carbidopa-levodopa, pramipexole, and rasagiline). He was admitted to the postanesthesia care unit at 12:45 AM following his surgery. Although he missed his 2 AM dosing of antiparkinson medications, he received his 6 AM dosing. According to the nursing notes, by 2:50 PM the patient's Parkinson's disease was stable, he was back on his full medication regimen, and he provided input regarding taking his medications.

DISCUSSION

In this study, the median duration of withholding of carbidopa-levodopa for patients whose surgical procedures required them to be on NPO status was approximately 12.5 hours for the entire sample, more than 16 hours for those having inpatient procedures, and more than 11 hours for those having outpatient procedures. Fifty-five (62%) of the 89 surgical events

had medication withholding times of 10 to 20 hours; and of the 32 inpatient procedures, nine (28%) resulted in withholding times of more than 30 hours. With inpatient procedures, the durations of NPO status and therefore of medication withholding are likely to be prolonged, and this was confirmed by our findings. Given the implications of prolonged withholding times on the therapeutic effects of carbidopa-levodopa, researchers and clinicians must ask how such times can be reduced. Operating room personnel, particularly certified registered nurse anesthetists, must be mindful that patients with Parkinson's disease can take carbidopa-levodopa and other antiparkinson medications with a sip of water until shortly before the initiation of anesthesia; and in many cases these medications can be resumed in the postanesthesia recovery unit.[18] In the presence of gastric discomfort, nausea, or vomiting, an orally disintegrating preparation of carbidopa-levodopa could be considered.

Patients can take antiparkinson medications with a sip of water until shortly before the initiation of anesthesia.

Forty-six percent of the surgical events reviewed in this study were started between 9 AM and 12 PM, with another 40% beginning after 12 PM; only 14% were started between 6 AM and 9 AM. Patients with Parkinson's disease who undergo surgery might

experience less medication disruption and perhaps better symptom management if their surgeries are scheduled as early in the day as possible.

The nursing notes analyzed in this study give particular insight into the challenges faced by patients with Parkinson's disease who undergo an inpatient surgical procedure. Those who missed several doses of carbidopa-levodopa experienced symptom exacerbations that included rigidity, agitation, difficulty swallowing, and hallucinations. It should be noted that patients with a diagnosis of dementia and patients with cardiovascular or respiratory illnesses that can lead to symptoms of hypoxemia and agitation were not excluded from the sample. With an average of 4.6 comorbidities per surgical event, excluding these patients might have resulted in our having no records to review.

patients were predominantly white and male. Further investigation into the effects of perioperative withholding of antiparkinson medications must include more varied patient populations. Second, the principal investigator and coinvestigator were two of the data abstractors, and this might have introduced a subjectivity bias into the data collection. Third, 16 of the 67 patients (24%) had more than one surgery during the data collection period; this might have introduced a bias in the characterization of the population. The present study was descriptive and no adjustment was made to account for the multiple procedures for these patients. Four, the cross-referenced sample list included numerous patients who either had not been diagnosed with Parkinson's disease or did not take any antiparkinson medications. Thus the number of excluded data records was larger than originally

Patients who missed several doses of carbidopa-levodopa experienced symptom exacerbations that included rigidity, agitation, difficulty swallowing, and hallucinations.

Patients with Parkinson's disease who have surgery often face multiple challenges, as they are likely to have comorbidities that affect their perioperative care and postoperative recovery. For the purposes of estimating mortality risk or analyzing reasons for hospital admission, several investigators have focused on the comorbidities associated with Parkinson's disease.[16, 17, 19] While the investigators all categorize comorbidities differently, it's clear that the comorbidity profile of the subjects in our study was similar to that of other studied groups.[16, 17, 19] In our study sample, cardiovascular disorders ranked high on the list of comorbidities, with the most common being hypertension (60%). Nonparkinsonian neurologic disorders such as stroke, depression, and dementia were also common. Although the type was not indicated, depression was a noted comorbidity in 18 (20%) of the 89 surgical events and in 14 (21%) of the 67 patients, which is a higher percentage than is found in the general elderly population. According to the National Institute of Mental Health, major depression occurs in fewer than 1% to 5% of community-dwelling older adults; the percentage rises to 11.5% of hospitalized older adults and to 13.5% of older adults who require home health care.[20] And our study sample had a higher incidence of genitourinary disorders compared with other studied groups,[16, 17, 19] perhaps because our sample was elderly and predominantly male.

Limitations. This study had a number of limitations. First, the results have limited generalizability because of the use of a purposive sample and because

anticipated, decreasing the number of patients eligible for inclusion in the study. Finally, with retrospective record review and computerized documentation, it can be difficult to piece together all the components of the patient's perioperative experience, especially when documentation of assessments and medication history does not exist or is incomplete.

FUTURE DIRECTIONS
The results of this study underscore further the need for broader and continuing research on the perioperative management of surgical patients with Parkinson's disease. Given the limited research available, it's perhaps too early to make recommendations about how to improve the perioperative management of these patients. That said, we offer the following suggestions for careful consideration. Supplemented with additional research, they may facilitate the development and implementation of improved guidelines for the perioperative management of surgical patients with Parkinson's disease.

Suggestions. *Provide comprehensive education for nurses who care for these patients.* This includes nurses who work in preoperative preparation areas, surgical suites, postanesthesia recovery units, and surgical wards. In particular, nursing education should stress the importance of patients continuing to take their antiparkinson medications with a sip of water up until shortly before the initiation of anesthesia, and of their resuming these medications as soon as possible after surgery (often as early as in the postanesthesia

recovery unit). Education about the complexity of antiparkinson medication regimens, contraindicated medications for patients with Parkinson's disease, and the importance of accurate documentation of dosage times is also essential.

Offer education for anesthetists. An educational program should be developed specifically for anesthetists, emphasizing the importance of patients continuing to take their antiparkinson medications for as long as possible before the initiation of anesthesia. In some situations it might be advisable to administer carbidopa-levodopa as an orally disintegrating tablet (Parcopa) given on the tongue during surgery, or by crushing a regular oral tablet for delivery through a nasogastric tube. The educational program should also include a review of contraindicated medications.

Consider the timing and scheduling of surgery. Surgeons and other schedulers should be aware of the benefits of scheduling patients with Parkinson's disease for surgery early in the day, so as to minimize disruptions to the antiparkinson medication regimen. This approach is particularly important in institutions that typically place patients on NPO status after midnight for surgical procedures occurring the next day.

Provide relevant education to patients and family members. Perhaps most important, patients with Parkinson's disease and their families should be educated about medication management in the perioperative period. Patients should be advised to bring their antiparkinson medications with them and encouraged to become their own best advocates. In a second, qualitative study, we found that patients who were well informed and had an advocate (usually a family member) while in the hospital typically fared better during the perioperative period. In this companion study, we also found that when hospital nurses were flexible with carbidopa-levodopa administration times in response to patients' self-expressed needs, the patients had better outcomes and were much happier with the hospital experience. (See next month's *AJN* for more on findings from the qualitative study.)

In the study reported here, patients with Parkinson's disease who underwent surgery experienced prolonged medication withholding times, an observation that has implications extending beyond the perioperative period to any hospitalization. This finding might also be important for other patient populations who are on medications for which a steady state concentration must be maintained. Nurses can and should take the lead in ensuring that patients with Parkinson's disease receive their medications on time, that disruptions to the regimen are minimized, and that optimal symptom management is achieved. ▼

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