

The Feasibility and Perioperative Complications of Outpatient Knee Arthroplasty

Richard A. Berger MD, Sharat K. Kusuma MD,
Sheila A. Sanders RN, Elizabeth S. Thill RN,
Scott M. Sporer MD

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Abstract The duration of hospitalization and subsequent length of recovery after elective knee arthroplasty have decreased. We hypothesized same-day discharge following either a unicompartmental (UKA) or total knee arthroplasty (TKA) in an unselected group of patients would not result in a higher perioperative complication rate than standard-length hospitalization when following a comprehensive perioperative clinical pathway, including preoperative teaching, regional anesthesia, preemptive oral analgesia, preemptive antiemetics, and a rapid rehabilitation protocol. We prospectively followed 111 of all 121 patients who had primary knee arthroplasty completed by noon and who agreed to be followed prospectively; 25 had UKA and 86 TKA. Of the 111 patients, 104 (94%, 24 with UKA and 80 with TKA) met discharge criteria and were discharged directly to home the day of surgery. Nausea requiring additional treatment before discharge was the most common reason for a delay in discharge. There were four (3.6%) readmissions (all with TKA) and one emergency room visit without readmission (in a patient with a TKA) within the first week after surgery, while there were four subsequent

readmissions (3.6%) and one additional emergency room visit without readmission within three months of surgery, all among patients undergoing TKA. There were no deaths, cardiac events, or pulmonary complications during this study. Outpatient knee arthroplasty surgery is feasible in a large percentage of patients yet early readmissions may be decreased with a prolonged hospitalization.

Level of Evidence: Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) have traditionally been considered inpatient surgical procedures. The reasons for maintaining patients in the acute care hospital setting immediately after TKA have included patient and physician concerns about uncontrolled pain, decreased mobility, and the possibility of perioperative complications. However, the average length of stay after TKA and UKA has decreased substantially in recent years through the judicious use of improved postoperative clinical pathways [5, 7, 8]. These pathways have included improved pain management protocols, early mobilization, and meticulous monitoring and early preventive intervention for common postoperative medical complications. Previous authors have demonstrated the average length of stay can be decreased without increasing perioperative complication rates or decreasing patient satisfaction [6, 9]. Some authors have also reported decreasing the length of hospitalization can minimize complications, improve outcomes, and increase patient satisfaction after total joint arthroplasty [5, 7, 8, 11]. Anterior cruciate ligament reconstruction, laparoscopic

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Each author certifies that our institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.

R. A. Berger (✉), S. K. Kusuma, S. A. Sanders,
E. S. Thill, S. M. Sporer
Department of Orthopaedic Surgery, Rush Medical College,
Rush-Presbyterian-St. Luke's Medical Center, 1725 West
Harrison Street, Suite 1063, Chicago, IL 60612, USA
e-mail: r.a.berger@sbcglobal.net

cholecystectomy, and laparoscopic appendectomy are examples of surgical procedures previously necessitating inpatient hospitalization that are now routinely performed safely and effectively as outpatient procedures [10].

Several authors also report outpatient TKA with direct home discharge [3, 4]. The feasibility of this approach is presumed to be the result of several factors, including a new surgical approach that minimizes both soft tissue damage and disruption of the extensor mechanism, perioperative anesthesia that minimizes general anesthesia, and accelerated rehabilitation protocols that allow early discharge [3, 12]. While these previous reports have demonstrated the feasibility of TKA as an outpatient procedure, they were performed on a highly select patient population. These previous studies have not attempted to recognize potential problems, which may occur when trying to apply these outpatient protocols to unselected patients undergoing TKA [3, 4, 12].

We hypothesized same-day discharge following either a unicompartamental or total knee arthroplasty in an unselected group of patients will not result in a higher perioperative complication rate than standard-length hospitalization. We also hypothesized the perioperative complication rate of same day discharge among patients undergoing UKA versus TKA would be similar.

Materials and Methods

Between January 2006 and October 2006, 121 primary knee arthroplasty surgeries had their procedures completed by noon on the day of surgery. This time frame reflected our initial experience with outpatient total knee and UKA in an unselected group of patients. No patients were excluded from the study during the inclusion dates and the restriction of surgery before noon. However, 10 patients declined to be included in this study and their data were not collected or reported. Therefore, 111 patients were enrolled to assess the feasibility and potential problems of discharging patients directly to home on the day of their knee arthroplasty. The group of 111 study patients included 25 UKAs and 86 TKAs. The average age of the 111 patients was 65 years (range, 48–85 years) and included 45 female and 66 male patients. The average weight was 88 kg (range, 51–127 kg) and the average body mass index (BMI) was 28.8 kg/mm² (range, 18.8–43.2 kg/mm²). The preoperative diagnosis was osteoarthritis in 102 patients, osteonecrosis in one, posttraumatic in five, and rheumatoid arthritis in three.

All patients were enrolled in a comprehensive clinical pathway that encompassed the preoperative, intraoperative, and postoperative periods. This pathway included care provided by the anesthesia team, the orthopaedic surgery

team, perioperative and postoperative nursing, physical/occupational therapy, and the social work/discharge planning team [2, 3, 12].

Preoperatively, all patients were required to attend a class conducted by a clinical nurse or therapist [12]. This class was designed to expose the patient to all aspects of the perioperative experience and to prepare them for same-day discharge after knee arthroplasty. All patients also underwent a preoperative medical evaluation by an internist on staff at our medical center and were required to be an acceptable surgical risk for TKA. Patients did not receive any special or additional consideration or clearance for same-day discharge other than that of a standard-length hospitalization knee arthroplasty preoperative evaluation.

On the morning of surgery, before undergoing the procedure, all patients received a very specific combination of antiinflammatory and narcotic analgesics [3, 4] that included either 400 mg Celebrex[®] (celecoxib; Pfizer, Princeton, NJ) along with 10 mg OxyContin[®] (oxycodone hydrochloride sustained release; Purdue Pharma, Stamford, CT). Our anesthetic technique included an epidural catheter without narcotic infusion that was placed in the preoperative holding area. The inability to place an epidural catheter was the only indication to utilize general anesthesia. Epidural or intravenous narcotics were not infused during surgery. A Foley catheter was placed in all cases, and all patients received intravenous prophylactic antibiotics before the skin incision. The very short-acting agent Diprivan[®] (propofol; AstraZeneca Pharmaceuticals, Wilmington, DE) was titrated intraoperatively for sedation. Intraoperatively, patients also received 4 mg Zofran[®] (ondansetron hydrochloride; GlaxoSmithKline, Philadelphia, PA), 20 mg Pepcid[®] (famotidine; Johnson & Johnson, New Brunswick, NJ), and 10 mg Reglan[®] (metoclopramide; Wyeth Pharmaceuticals, Madison, NJ) to decrease postoperative nausea. Thirty milligrams of intravenous Toradol[®] (ketorolac; Hoffmann-La Roche Inc, Nutley, NJ) was given intraoperatively for improved pain control. Patients were also aggressively hydrated to prevent postoperative hypotension and nausea. Intraoperatively, the epidural infusion and the rate of propofol infusion were titrated to achieve the minimal amount of sedation and analgesia to comfortably perform the procedure.

All operations were performed by one surgeon (RAB). The surgical technique for all patients consisted of a small incision technique that avoided disruption of the quadriceps tendon or vastus medialis obliquus muscle [1]. In all cases, patellar eversion, knee dislocation, and knee hyperflexion were avoided. A posterior cruciate ligament-retaining prosthesis was utilized in all TKA cases (Nex-Gen[®]; Zimmer, Inc, Warsaw, IN). While a fixed-bearing unicompartamental system was utilized in all UKA cases (Unicompartamental High Flex Knee, Zimmer). A suction-

reinfusion drain was placed in all patients at the completion of the surgery. Average surgical times were 103 minutes (range, 78–126 minutes), average tourniquet time was 108 minutes (range, 82–132 minutes), and average incision length was 9.1 cm (range, 7–11.2 cm).

An immediate postoperative protocol was also consistently applied to all patients in the recovery room that included a second dose of 4 mg Zofran[®] combined with aggressive intravenous hydration therapy to prevent hypotension and nausea [1, 3]. Epidural analgesia (10 µg/mL fentanyl + 0.1% bupivacaine) at 6 mL, 1 mL every 15 minutes with a 40-mL 4-hour lockout, was continued.

Two hours after surgery, the Foley catheter was removed and an additional 20 mg oral OxyContin[®] was administered (10 mg for patients older than 70 years or weighing less than 54 kg). Patients received Norco[®] 10-mg tablets (hydrocodone + acetaminophen; Watson Pharmaceuticals, Corona, CA) for breakthrough pain. The epidural catheters were removed 4 hours after surgery, and if enough blood (>200 mL) was collected in suction-reinfusion drain, the blood was transfused. The intravenous tubing was removed at the completion of the autotransfusion with the maintenance of a heparin lock to allow for ease of physical therapy.

Physical therapy was initiated within 5 to 6 hours after surgery. Patients were made immediately weight bearing as tolerated with assistive devices (cane or crutch) and then promptly advanced to no assistive devices. Patients were required to fulfill standard hospital physical therapy discharge milestones before being discharged to home. These criteria included the ability to independently move from a supine bed position to a standing position and to return from an upright standing position to a supine bed position. Additionally, patients were required to independently transfer to and from a chair and a standing position. The final physical therapy milestones were the ability to ambulate at least 100 feet without assistance and the ability to ascend and descend a full flight of stairs. A final dose of intravenous antibiotics was given after completion of physical therapy with no further antibiotics administered postoperatively.

If patients experienced any difficulties with nausea, pain, hypotension, dizziness, or oversedation, one of the clinical nurses was called quickly to respond. Nausea that was not related to position was treated with 10 mg Reglan[®] and 4 mg Zofran[®], whereas positional nausea or nausea related to orthostatic hypotension was treated with intravenous fluid boluses until the symptoms resolved. Pain was treated initially with Norco[®] 10-mg tablets (Norco[®] 5-mg tablets were used for patients older than 70 years or weighing less than 54 kg). If the oral narcotics were not sufficient, then additional oral agents and/or intravenous morphine were used until the pain was controlled.

Hypotension and positional dizziness was treated with fluid boluses. Oversedated patients were generally treated by observation and allowance of the narcotic medication effects to diminish. In rare cases, Narcan[®] (naloxone hydrochloride; Endo Pharmaceuticals, Chadds Ford, PA) was used for opioid reversal.

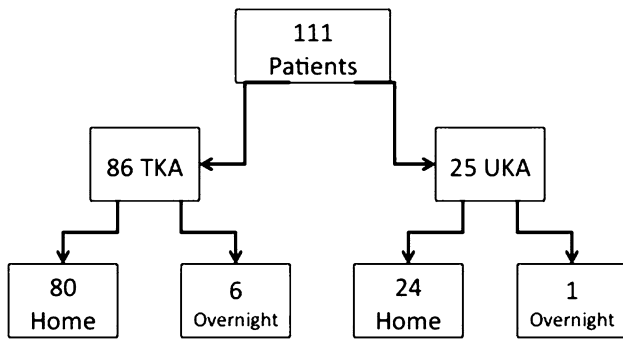
Patients were required to demonstrate stable vital signs of heart rate, blood pressure, respiratory rate, and temperature during physical therapy activities before being considered a candidate for home discharge. The ability to tolerate a regular diet and maintain adequate pain control with oral pain medication was also paramount to discharge. Only after all of the above criteria were met were the patients given the option of discharge to home.

The 111 patients enrolled in this study were followed prospectively for 3 months to catalog the postoperative complications and the clinical results of their knee arthroplasties. We achieved 100% followup of study patients during the study period. Our clinical staff followed all patients closely by telephone and office followup visits after their same-day discharge to home. We catalogued all incidences of early postoperative emergency room visits and hospital readmissions for any reason. Patients were seen in our outpatient office at 1 week, 2 weeks, 6 weeks, and 3 months postoperatively.

We compared the age, weight, and BMI between the UKA and TKA groups using an unpaired two-tailed Student's *t* test. Additionally, we compared the patients who were successfully discharged on the day of surgery and those patients who remained in the hospital for one night using an unpaired two-tailed Student's *t* test. All data analysis was performed utilizing the Microsoft[®] Excel[®] (Microsoft Corp, Redmond, WA) and STATA[®] (StataCorp LP, College Station, TX) software packages.

Results

Of the 111 patients, 104 (94%) were discharged directly to home on the day of surgery while seven were hospitalized overnight (Fig. 1). Of the seven patients (six with TKA and one with UKA) who stayed overnight, four (all of whom had TKA) remained hospitalized due to difficulty with pain control. These four patients had their surgeries completed between 11 a.m. and noon. One hospitalized patient had chest pain that required a workup for myocardial infarction, which was negative, and one patient chose not to leave the hospital due to apprehension and fear of discharge. These two patients had also undergone TKA procedures. The one UKA patient who required an overnight stay experienced nausea that could not be adequately controlled on the day of surgery. Similar percentages ($p = 0.59$) of patients with TKA and UKA required overnight hospitalization (six of



6 Overnight Patients:
 • 4 – Pain
 • 1 – Chest Pain
 • 1 – Fear of Discharge

1 Overnight Patient:
 • 1 - Nausea

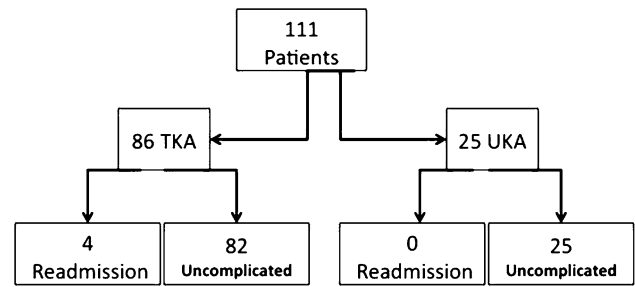
Fig. 1 Patients with a same day discharge following a rapid rehabilitation protocol following total and unicompartmental knee arthroplasty are shown in a flowchart. Note the perioperative reasons for overnight hospitalization.

86 or 7% TKA patients and one of 25 or 4% of UKA). All seven patients successfully and easily met discharge criteria by the morning of postoperative Day 1 and were discharged to home at that time. The 104 patients who were successfully treated as outpatients and the seven patients who required an overnight stay had similar average age ($p = 0.46$), body weight ($p = 0.47$), and BMI ($p = 0.17$).

There were four (3.6%) acute hospital readmissions for medical complications within the first week after surgery (Fig. 2). All of these patients had undergone a TKA procedure. Two of the four readmissions were for symptomatic anemia requiring a blood transfusion, one for gastrointestinal bleeding, and one for deep venous thrombosis. Additionally, there was one emergency room visit without readmission for uncontrolled nausea in a patient who had undergone a TKA. There was no difference ($p = 0.21$) for readmissions and emergency room visits within the first week for UKA versus TKA.

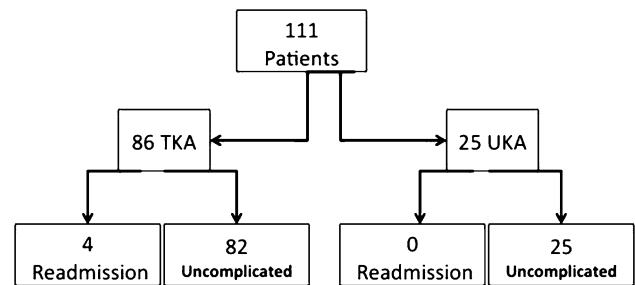
Between 1 week and 3 months after surgery, there were four (3.6%) additional readmissions (Fig. 3) all in patients with a TKA. Two of the four readmissions were for wound complications necessitating superficial irrigation and débridement, one for manipulation under anesthesia for stiffness, and one for a gastrointestinal bleed. There was one additional emergency room visit without readmission within this period for benign lower extremity swelling. This patient also underwent TKA. There was no difference ($p = 0.21$) for readmissions and emergency room visits from the first week to the first month for UKA versus TKA.

There were no incidences of cardiac events, pulmonary embolus, or death within the first 3 months after surgery.



4 Readmission Patients:
 • 2 – Anemia
 • 1 – G.I. Bleed
 • 1 – DVT
 • (1 ER visit for nausea)

Fig. 2 Patients requiring readmission to the hospital following total and unicompartmental knee arthroplasty within the first week after surgery are shown in a flowchart.



4 Readmission Patients:
 • 2 – Superficial I&D
 • 1 – Manipulation Under Anesthesia
 • 1 – G.I. Bleed
 • (1 ER visit for benign swelling)

Fig. 3 Patients requiring readmission to the hospital following total and unicompartmental knee arthroplasty between the first week and three months after surgery are shown in a flowchart.

Discussion

The duration of hospitalization and subsequent length of recovery after elective knee arthroplasty have decreased due to minimally invasive surgical techniques, improved perioperative anesthesia, and an expedited rehabilitation protocol (Appendix 1). The purpose of this study was to detail the feasibility and problems associated with outpatient knee arthroplasty surgery in an unselected group of 111 patients who had knee arthroplasty surgery completed before noon. We also identified the specific postoperative problems that resulted in a delayed discharge and compared the perioperative complications among patients receiving a TKA versus a UKA.

This study represented a consecutive cohort of patients undergoing primary knee arthroplasty. Potential limitations of this study include the relatively small sample size and as

a result the potential for a Type II error. The absence of reported differences in data between the patients with UKA and TKA may reflect such error. This study was also conducted at a medical center that has been using rapid rehabilitation protocols, minimally invasive techniques, and same-day discharge for many THA patients for several years. Consequently, the results of this study may not be applicable to medical centers that do not have experience with these protocols and do not have the level of support available as we did.

Analysis of the seven patients (6.1%) who were unable to be discharged home the same day revealed inadequate pain control was the most common reason for the delay. All four of these patients had undergone TKA and were unable to obtain adequate pain control to complete the pathway in time for same-day discharge. All four of these TKA patients had their surgeries completed between 11 a.m. and noon. This late completion of their surgery did not allow adequate time for the pathway and our nurse clinician to adjust the pain regimen and achieve a same-day discharge. Previous reports on outpatient TKA were in patients who underwent knee arthroplasty as the first surgery of the day (completion of surgery in the early morning) [3, 4]. In these reports of early in the day surgeries, no patient had pain control issues that could not be resolved before same-day discharge. Therefore, our findings, like those previously reported [3, 4], indicate our current pain management protocol allows sufficient time for post-TKA pain to be controlled when surgery is completed by the early or mid morning. However, for surgeries completed later in the morning or early afternoon, adequate pain control is more difficult to achieve and may require a more aggressive and proactive pain management protocol.

There were no differences in patients who required an overnight stay and those treated as an outpatient with regard to average age, body weight, BMI, or medical comorbidities. Because there were no differences in these parameters, it was not surprising we were able to achieve a 94% same-day discharge rate in this unselected group compared to the 96% to 98% same-day discharge rate of the carefully screened group from previous reports [3, 4]. Our current findings are in contrast to those of other authors who have examined the effects of these variables on the length of stay. Vincent et al. [14] reported patients older than 70 years had longer inpatient rehabilitation hospital stays after TKA [14]. Furthermore, other authors have demonstrated obese patients with a BMI of greater than 40 required longer length of stay after TKA [13, 15]. Notwithstanding these other reports and our own preconceived biases, the primary factor that prevented same-day discharge in our patient group was not BMI, comorbidities, or age, but rather TKA completed late in the morning and the difficulties in completing the pathway due to the late time.

Our data suggest, unlike discharge to home, postoperative hospital readmissions were related to BMI, medical comorbidities, and age. We found in our current unselected patient group that 3.6% of patients required hospital readmission within the first week after the surgery. In our previous reports, when more strict eligibility criteria were utilized to select patients for outpatient TKA, there were no readmissions within 1 week [3, 4]. Early postoperative readmissions within the first week in this current series were due to anemia, gastrointestinal bleeding, deep venous thrombosis, and nausea. These complications and subsequent readmissions might have been avoided if these patients had a standard postoperative hospital stay of 3 to 5 days. These acute hospital readmissions all occurred in patients who had undergone TKA. This result suggests two things: first, in our patient population, TKA patients are at higher risk for early postoperative complications than UKA patients. Second, the selection criteria we utilized in previous reports for outpatient knee arthroplasty candidates successfully screened out those patients who were at risk for early postoperative complications. The selection criteria used in previous studies included patients requiring a TKA without a history of prior open knee surgery younger than 80 years of age. In these previous studies, patients with a history of myocardial infarction within 1 year, prior pulmonary embolism, BMI of greater than 40, or greater than three medical comorbidities were excluded. Therefore, while the current study group had no exclusion criteria other than the patient agreeing to be enrolled in our study, we need to utilize more stringent screening criteria when selecting outpatient TKA candidates. These stringent screening criteria may not be necessary in surgical candidates for outpatient UKA.

For readers who want to consider this approach, with or without exclusion criteria, a word of caution is appropriate. We have been refining same-day discharge for hips since 2001 and knees since 2003. Our high discharge rate of 94% in this series of unselected patients may suggest even patients with multiple medical comorbidities, high BMI, and increased age can be discharged home the day of surgery. However, the 3.6% incidence of readmission within the first week may have been reduced by a prolonged hospital stay. Furthermore, our high percentage of same-day discharge may also reflect our long experience with this process. However, this high percentage of same-day discharge may simply reflect the expertise developed by our team in remedying problems that inevitably arise in the perioperative period. With this experience, we suggest those who want to adopt this methodology start with a slow and gradual reduction in their length of hospital stay, similar to the protocols we followed early in our learning process. We recommend initially beginning by reducing the length of stay in a large cohort of patients from 3 to

4 days to 2 days. Once this has been successfully implemented, we then recommend the careful selection and intense monitoring of healthy patients for knee arthroplasty with a 1-day hospitalization. Only when patients and surgeons are comfortable with next-day discharge should same-day discharge be attempted on healthy patients. Having discharged more than 1500 patients on the day of surgery and more than 1500 patients on the day after surgery, we can conclude it is many times more difficult for the team to discharge a patient on the day of surgery than on the day after surgery. Everything must be perfectly executed to do outpatient total joint arthroplasty; any error or delay from any part of the team will result in failure of the outpatient goal. Lastly, we suggest beginning outpatient knee arthroplasty with UKAs rather than TKAs; the UKAs develop fewer perioperative problems that can delay same-day discharge and are less likely to have postdischarge problems and readmissions.

Our report demonstrates several important findings regarding outpatient knee arthroplasty. First, even in an unselected group, outpatient knee arthroplasty can be accomplished in a high percentage of patients as long as their surgery is completed early in the day to allow time for proper medication adjustments. Secondly, patient age, weight, and BMI do not appear to be limiting factors for outpatient knee arthroplasty. Finally, early hospital readmissions may be higher in an unselected group, and therefore a more stringent screening process is recommended to avoid postdischarge readmissions.

Appendix 1 [4]

Pre-op

Internist appointment for medical clearance
Teaching Class
Go through risks and benefits of surgery
Explain rapid discharge protocol
Session of physical therapy

Morning of surgery

Celebrex 400 mg orally
OxyContin 10 mg orally

Intra-op

Epidural anesthesia with Fentanyl 5mcg/cc and
Marcaine 0.1%
Preventative measures for side effects include:
Reglan 10 mg

Zofran 4 mg
Pepcid 20 mg
Toradol 30 mg

Twilight sedation with Propofol drip titrated to mcg/kg
(per body weight)
Local infiltration of surgical area with Marcaine 0.25%
(per body weight)

Post-op

Give post-op dose of OxyContin as soon as patient is in
PAR
10 mg for patients over 70 years old
20 mg for patients under 70 years old
Patients are given a fluid bolus of 500 cc of Lactated
Ringers
Remove epidural—2 hours after surgery
Change surgical dressing and remove drains—3 hours
after surgery
Physical therapy session with WBAT—4 hours after
surgery
Discharge patient, if medically stable, comfortable on
oral analgesia, and patient agrees

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