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Outpatient total knee arthroplasty: is it worth considering?

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- Some authors have reported that outpatient total knee arthroplasty (TKA) is a successful, safe and cost-effective treatment in the management of advanced osteoarthritis.
- The success obtained has been attributed to the coordination of the multidisciplinary team, standardized perioperative protocols, optimal hospital discharge planning and careful selection of patients.
- One study has demonstrated a higher risk of perioperative surgical and medical outcomes in outpatient TKA than inpatient TKA, including component failure, surgical site infection, knee stiffness and deep vein thrombosis.
- There remains a lack of universal criteria for patient selection. Outpatient TKA has thus far been performed in relatively young patients with few comorbidities.
- It is not yet clear whether outpatient TKA is worth considering, except in very exceptional cases (young patients without associated comorbidities).
- Outpatient TKA should not be generally recommended at the present time.

Keywords: outpatient; results; total knee arthroplasty

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Introduction

Total knee arthroplasty (TKA) has proven to be a successful, safe and cost-effective treatment in the management of advanced osteoarthritis. The incidence of TKA has increased steadily in the last decade and is expected to increase by 143% between 2012 and 2050.[1] In light of these data, there is a need, and frequently a financial incentive, to manage resources in the most efficient way possible. Therefore, outpatient TKA has begun to be implemented in selected groups of patients. Currently, approximately 5% of all TKAs are performed on an outpatient basis.[2] Lovald et al have reported that outpatient TKA (duration of hospital stay < 1 day) reduced costs by US$8,527, compared with patients admitted to the hospital for 3–4 days.[3] The purpose of this review article is to better understand the outcomes of outpatient TKA, to determine whether it is worth consideration.

Inclusion criteria for outpatient TKA

In 2017, Gromov et al reported the following criteria for discharge on the day of surgery (DOS):[4] < 500 mL intraoperative blood loss; back in patient ward before 3 pm; received instruction from physiatrist and is safely mobilized; no clinical symptoms of anaemia (paleness, dizziness during mobilization, fatigue); pain < 3 while resting, < 5 during mobilization; spontaneous urination; postoperative radiograph approved; relative or friend with patient for > 24 hours; motivated and accepts same-day discharge; standard discharge criteria fulfilled (ability to get dressed independently, ability to get in and out of bed, ability to sit and rise from a chair/toilet, independence in personal care, mobilization with walker/crutches, ability to walk > 70 m with crutches).

The selection criteria for patients who seek to undergo outpatient TKA remain controversial. For this, several scoring and classification systems of morbidity have been used, with varying degrees of success. Among them, the classification of the American Society of Anesthesiologists (ASA), the Charlson Comorbidity Index (CCI) and the Assessment of Ambulatory Arthroplasty Risk (AAAR) stand out. Other important factors inherent to the patient are body mass index (BMI), physical and cognitive function and the presence of social support at home.[5]

In 2018, Gogineni et al reported three main groups of factors (inclusion criteria) for outpatient TKA:[6] (1) surgical factors (primary TKA and first/second case of the day); (2) medical factors (age < 75 years; BMI < 35; no anaemia; no chronic obstructive pulmonary disease; no congestive heart failure; no cirrhosis; no venous thromboembolism; no spinal stenosis; no benign prostate hyperplasia; no chronic narcotics; and surgeon discretion); (3) social factors (risk assessment and prediction tool > 10; proximity to hospital; and private insurance).[6]

Is outpatient TKA safe?

Outpatient TKA has been shown to be safe, has a low rate of hospital readmission and is economically advantageous. In fact, clinical results as good as those obtained in hospitalized patients have been reported.[7] In 2018 Shah et al reported that outpatient total joint arthroplasty (TJA) with discharge to home at a freestanding, independent ambulatory surgical centres is a safe option after development of a multidisciplinary TJA pathway.[8]

Results and complications of outpatient TKA

A recent systematic review published by Hoffman et al reported that, of a total of 1009 patients, only one presented a major complication. There were no deaths, and the reoperation rate was only 2%.[9]

In one study, at the end of the follow-up, the range of motion (ROM) and function of the knee were similar to those for ambulatory TKA and to the TKA of admitted patients.[10] Dorr et al found that 96% of the patients who underwent outpatient TKA reported that they would undergo the procedure again.[11] Parcells et al reached the same conclusion.[12] In 2016, Lovecchio et al compared outpatient arthroplasty with fast-track inpatient arthroplasty, and found that outpatients experience higher rates of post-discharge complications.[13]

It is noteworthy that a study published by Arshi et al in 2017 demonstrated a higher risk of perioperative surgical and medical outcomes in outpatient TKA than inpatient TKA, including component failure, surgical site infection, knee stiffness and deep vein thrombosis.[14]

According to Gogineni et al, outpatient total hip arthroplasty (THA) and TKA in a well-selected patient is feasible in an academic multidisciplinary tertiary care hospital, with complication rates approximating those of inpatient surgery.[6]

In 2019, Bilgen et al stated that early discharge of patients following outpatient surgery for TKA was not associated with any procedure-related complications among the selected patients up to three months postoperatively.[15]

Gromov et al analysed all consecutive and unselected patients scheduled for THA or TKA at two participating hospitals who were screened for potential DOS discharge. Readmission rates in patients discharged on DOS may be similar to matched patients with at least one overnight stay. With the selection criteria used, there may be no safety signal associated with same-day discharge (SDD).[16]

In 2019, Crawford et al reported the incidence of complications associated with outpatient TKA, and the two-year minimum results. They found that outpatient TKA is safe for a large proportion of patients. Certain medical comorbidities increase the risk of overnight stay. Patients had significant improvement in ROM and outcome scores with low revision rate.[17] Table 1 summarizes the main results of outpatient TKA in the literature.[3,4,6–8,13–28]

Requirements for performing a successful outpatient TKA

Fundamental to successful outpatient TKA is the safety of the patient, who should never be at risk. Success requires a multidisciplinary approach that includes extensive preoperative patient education, optimal control of nausea and pain and early and intensive mobilization under supervision.[5]

Preoperative considerations

Appropriate patient selection is fundamental to guaranteeing the optimal time of discharge, a low rate of readmission and the fewest possible complications. Currently, the ideal risk assessment tool for choosing the right patients is unknown. It has been reported that the AAAR based on nine comorbidity areas is a better indicator to predict readmission than the ASA classification and the CCI.[29] A recent systematic review of outpatient hip and knee arthroplasty found that, of a total of 1009 patients, 95% were discharged on the same day of surgery, and only approximately 1% were readmitted within the first 90 days.[9] The vast majority of patients were young (average age approximately 60 years), and had been preselected based on their low level of comorbidity. However, the selection criteria for patients who seek to undergo outpatient TKA remain controversial. In older patients, further investigation is necessary. Currently, obstructive sleep apnoea, poor patient balance, cognitive deficiencies and lack of social support are considered contraindications.[5]

Once selected for outpatient TKA, the patient should be well informed about the procedure before surgery. The objective is to understand the expectations the patient has of the intervention.

Perioperative considerations

In ambulatory settings, the results of neuraxial anaesthesia and those of modern general anaesthesia have been shown to be comparable.[30] Neuraxial anaesthesia should avoid opioids and be short acting; the objective is to prevent postoperative urinary retention and allow the patient to walk as soon as possible.[31]

To facilitate discharge, it is necessary to optimize the control of perioperative pain, which allows the patient to return to normal activity at home. Pain control is achieved via preventive multimodal analgesia. Peripheral nerve blocks commonly used in TKA are blockage of the adductor canal and infiltration between the popliteal artery

Table 1. Main results of outpatient total knee arthroplasty (TKA) in the literature

Authors	Year	Results	Comments from the original publications
Berger et al[18]	2005	A total of 48/50 patients (96%) chose to go home the day of surgery. No intraoperative complications occurred. There were three readmissions, none related to early discharge: gastrointestinal haemorrhage at eight days, superficial irrigation and debridement at 21 days and a closed manipulation at nine weeks.	This study demonstrated that, in these selected patients, outpatient TKA was safe, with no short-term readmission or complications related to early discharge. This comprehensive pathway might make it possible for this minimally invasive TKA to be performed as an outpatient procedure in specialized surgicentres in the future.
Berger et al[19]	2009	Of 111 patients, 104 (94%), 24 with unicompartmental knee arthroplasty (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, whereas 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 might be decreased with a prolonged hospitalization. Level IV of evidence.
Lovald et al[3]	2014	TKA patients were identified in the Medicare 5% sample (1997–2009) and separated into the following groups: outpatient, 1–2 days, 3–4 days, or 5+ days inpatient. At two years, costs associated with the outpatient and the 1–2 day stay groups were US$8527 and $1967 lower than the 3–4 day stay group, respectively. At two years, the outpatient and 1–2 day stay groups reported less pain and stiffness, respectively, although the 1–2 day stay group also had a higher risk for revision.	NA
Lovald et al[20]	2014	The Medicare 5% limited data set sample was used to identify patients with a TKA procedure who were treated in an outpatient setting or who were discharged within one or two days in the hospital setting. Rehospitalization risk increased with higher CCI (i.e. poorer health status), older patients, inpatients (vs. outpatients), patients not receiving a femoral nerve block, earlier (vs. recent) year of surgery and those with a recent history of heart failure.	The findings of this study suggest that current comorbidities, particularly heart failure, have the greatest effect on event risk after outpatient and short-stay TKA. The information obtained from this study should assist with patient selection for TKA performed on an outpatient basis.
Pollock et al[7]	2016	Systematic review. Of the 17 included studies, four were cohort studies with a control group and 13 were case series. All four cohort studies indicated that the complication rates and clinical outcomes were similar between the inpatient and outpatient groups. Furthermore, the three studies that involved an economic analysis indicated that outpatient arthroplasty is financially advantageous.	In selected patients, outpatient THA, TKA, and UKA can be performed safely and effectively. The included studies lacked sufficient internal validity, sample size, methodological consistency and standardization of protocols and outcomes. There is a need for high-quality prospective cohort studies and randomized trials to definitively assess the safety and effectiveness of outpatient THA, TKA and UKA.
Lovecchio et al[13]	2016	These authors compared outpatient arthroplasty and fast-track inpatient arthroplasty. All patients undergoing THA or TKA between 2011 and 2013 were selected from the American College of Surgeons-National Surgical Quality Improvement Program database. A propensity score was used to match 1476 fast-track ($\leq$ 2 day length of stay) inpatients with 492 outpatients (3:1 ratio). Thirty-day complication, reoperation, and readmission rates were compared, both during and after hospitalization. After matching, outpatients had higher rates of medical complication (anytime, 10.0% vs. 6.7%). Most complications were bleeding requiring transfusion, which occurred at similar rates after surgery but at higher rates post discharge in outpatients (anytime, 7.5% outpatients vs. 5.6% inpatients; post discharge, 4.1% outpatients vs. 0.1% inpatients). There was no difference in readmission rate (2.4% outpatient vs. 2.0% inpatient).	Outpatients experience higher rates of post-discharge complications, which may countermand cost savings. Surgeons wishing to implement outpatient TJA clinical pathways must focus on preventing post-discharge medical complications to include blood management strategies.
Springer et al[21]	2017	A retrospective review of 137 patients undergoing outpatient TJA and 106 patients undergoing inpatient (minimum two-day hospital stay) TJA was conducted. Unplanned hospital readmissions and unplanned episodes of care were recorded. All patients completed a telephone survey. Seven inpatients and 16 outpatients required hospital readmission or an unplanned episode of care following hospital discharge. Readmission rates were higher for TKA than THA. The authors found no statistical differences in 30-day readmission or unplanned care episodes.	NA
Courtney et al[22]	2017	Of the total 169,406 patients who underwent TJA, 1220 were outpatients (0.7%). The outpatient and inpatient groups had an overall complication rate of 8% and 16%, respectively. Patients aged older than 70 years, those with malnutrition, cardiac history, smoking history or diabetes mellitus were at higher risk for readmission and complications after THA and TKA. Surprisingly, outpatient TJA alone did not increase the risk of readmission or reoperation, and was a negative independent risk factor for complications.	With the resources available in a hospital setting, outpatient TJA might be a safe option, but only in select, healthier patients. Care should be taken to extrapolate these results to an outpatient facility, where complications might be more difficult to manage.

(continued)

Table 1 (continued)

Authors	Year	Results	Comments from the original publications
Huang et al[23]	2017	In every case-control match, the SDD TKA was less costly than the inpatient procedure and yielded median cost savings of approximately 30%. The savings came primarily from costs associated with the inpatient encounter, such as surgical ward, pharmacy and patient meal costs. At one year, there were no major complications and no returns to hospital or readmission encounters for either group.	These results were consistent with previously published data on the cost savings associated with short-stay or outpatient TKA. In carefully selected patients, outpatient TKA is a feasible alternative to traditional inpatient TKA and is significantly less costly. Furthermore, it was deemed to be safe in the perioperative period.
Bovonratwet et al[24]	2017	Patients who underwent primary, elective TKA were identified in the 2005–2014 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. A total of 112,922 TKA patients met the inclusion criteria. Of these, only 64 (0.57%) were outpatient procedures. Outpatients tended to be men, slightly younger and have less comorbidity. After propensity matching, a multivariate analysis revealed a higher rate of postdischarge blood transfusions ($P < .001$) in the outpatient cohort. There were no other significant differences in 30-day postoperative individual adverse events or readmissions.	Based on the perioperative outcome measures studied here, outpatient TKA can be appropriately considered in select patients based on rates of overall perioperative adverse events and readmissions. However, higher surveillance of these patients postdischarge might be warranted.
Gromov et al[4]	2017	Of the 557 patients who were referred to the participating surgeons during the study period, 54% were potentially eligible for outpatient surgery. Actual DOS discharge occurred in 13–15% of the 557 patients. Female sex and surgery late in the day increased the odds of not being discharged on the DOS.	This study showed that even in unselected THA and TKA patients, SDD is feasible in approximately 15% of patients.
Arshi et al[14]	2017	Cohorts of 4391 patients who underwent outpatient TKA and 128,951 patients who underwent inpatient TKA were identified. The median age was in the 70- to 74-year age group in both cohorts. The incidence of outpatient TKA increased across the study period. After adjustment for age, sex, and CCI, outpatient TKAs were found to more likely be followed by tibial and/or femoral component revision due to a non-infectious cause, explantation of the prosthesis, irrigation and debridement and stiffness requiring manipulation under anaesthesia within one year. Outpatient TKA was also more frequently associated with postoperative deep vein thrombosis and acute renal failure.	Nationwide data from a private insurance database demonstrated a higher risk of perioperative surgical and medical complications in outpatient TKA than inpatient TKA, including component failure, surgical site infection, knee stiffness and deep vein thrombosis. Level III of evidence.
Courtney et al[25]	2018	Of the 49,136 Medicare-aged TKA patients, 365 (0.7%) were outpatient, 3033 (6%) were short-stay and 45,738 (93%) were inpatient. Short-stay patients had a lower complication rate than both the outpatient and inpatient groups (2% vs. 8% vs. 8%, respectively). Independent risk factors for experiencing a complication or requiring an inpatient stay include female sex, general anaesthesia, diabetes mellitus, chronic obstructive pulmonary disease, hypertension, kidney disease, ASA Score 4, body mass index > 35 kg/m^2 and age > 75 years.	TKA can be performed safely as an outpatient in a subset of healthy Medicare patients with a complication rate similar to an inpatient stay. A 23-hour stay, however, might be the 'sweet spot' that minimizes complications in this population.
Gauthier-Kwan et al[26]	2018	A comparative cohort study of 43 inpatients (43 TKAs) and 43 outpatients (43 TKAs). Quality of recovery (QoR) was similar in the outpatient TKA group compared with the inpatient group. No statistically significant differences were observed for Knee Injury and Osteoarthritis Outcome Score and Western Ontario and McMaster Universities Osteoarthritis Index subscores. There was one readmission in both the outpatient and inpatient groups. Six inpatients and eight outpatients returned to the emergency department for any reason within 90 days, with no significant differences observed between the two groups.	Outpatient TKA in selected patients produced similar short-term and two-year patient-reported outcome measures and a comparable 90-day postdischarge hospital resource use compared with an inpatient cohort, supporting further investigation into outpatient TKA.
Husted et al[27]	2018	This study presented baseline detailed economic calculations of outpatient THA and TKA in two different settings: one from the hospital and another from the ambulatory surgery department. Patients and methods: Data from six patients (1 TKA, 1 uncemented THA, 1 cemented THA in each department) were collected prospectively using the Time Driven Activity Based Costing method (TDABC). Time consumed by various staff members involved in patient treatment in the perioperative period of outpatient THA and TKA was calculated in two different settings: one in the orthopaedic department and one in the ambulatory surgery department. Length of stay (LOS) was approximately 11 hours in the orthopaedic department and approximately seven hours in the ambulatory surgery department. TDABC revealed minor differences in the operative settings between departments, and similar expenses occurred during the short stay of US$777 and US$746, respectively. Adding the preoperative preparation and postoperative follow-up resulted in total costs of US$951 and US$942 for the ward and the ambulatory surgery department, respectively.	Outpatient THA and TKA in the hospital and ambulatory surgery departments results in similar cost using the TDABC method. Compared with the cost associated with two-day stays, outpatient procedures are approximately two-thirds cheaper, provided no increase occurs in complications or readmissions.

(continued)

Table 1 (continued)

Authors	Year	Results	Comments from the original publications
Cassard et al[28]	2018	Of 574 patients, 61 were selected to undergo outpatient TKA and 513 had inpatient TKA. The day-30 readmission rate was 2/61 (3.3%) in the outpatient group and 25/513 (4.9%) in the inpatient group. The overall complication rate was 8.0% for the outpatients and 7.2% for the inpatients. The satisfaction rate was high in the outpatient group, with 80% very satisfied and 20% satisfied patients.	When performed in appropriately selected patients, outpatient TKA is not associated with a higher readmission rate compared with inpatient TKA.
Shah et al[8]	2018	These authors evaluated 30-day and 90-day complication rates in patients who underwent outpatient TJA. Of the 90-day complication events, there were two patients (2%) with postoperative arthrofibrosis of the knee after TKA requiring manipulation under anesthesia, one postoperative patellar tendon rupture during therapy after TKA requiring surgical repair and one delayed hematogenous infection after international travel after THA requiring two-staged exchange.	Outpatient TJA with discharge to home is a safe option after development of a multidisciplinary TJA pathway.
Gogineni et al[6]	2018	This study analysed 105 consecutive patients who underwent THA or TKA following a newly implemented outpatient arthroplasty protocol. These authors compared these patients to a group of inpatient arthroplasty patients from the same time period. Eighty-three of 105 (79%) patients were successfully discharged home on the DOS. Successful same-day discharge was predicted by early ambulation, TKA over THA, and shorter duration of surgery. General anaesthesia correlated with better early ambulation distances and a lower incidence of urinary retention. The outpatient readmission and complication rates were 0.95% and 1.9%, respectively, whereas the matched inpatient rates were 3.7% and 2.9%, respectively.	Outpatient THA and TKA in a well-selected patient is feasible in an academic multidisciplinary tertiary care hospital, with complication rates approximating inpatient surgery.
Bilgen et al[15]	2019	This report anaylsed 31 patients (three male, 28 female), with a mean age of 67 years, who underwent TKA. The mean LOS was 28.7 hours and mean duration of surgery was 92 minutes. Combined spinal epidural anaesthesia was performed for 23 (74.2%) patients and general anaesthesia was used in eight (25.8%) patients. Among the 31 patients, 23 (74.2%) patients were discharged within 23 hours of surgery.	Early discharge of patients following outpatient surgery for TKA was not associated with any procedure-related complications among the selected patients up to three months postoperatively.
Gromov et al[16]	2019	In this study all consecutive and unselected patients scheduled for THA or TKA at two participating hospitals were screened for potential DOS discharge. Patients who fulfilled the DOS discharge criteria were discharged home. Patients discharged on DOS were matched on preoperative characteristics using propensity scores to patients operated on at the same two departments prior to the beginning of this study with at least one overnight stay. All readmissions within 90 days were identified. It was possible to match 116 of 138 outpatients with 339 inpatient controls. Median LOS in the control cohort was two days. Seven (6%) outpatients and 13 (4%) inpatient controls were readmitted within 90 days. Readmissions occurred between postoperative day 2–48 and day 4–58 in the outpatient and control cohorts, respectively. Importantly, we found no readmissions within the first 48 hours and no readmissions were related to the DOS discharge.	Readmission rates in patients discharged on DOS may be similar to matched patients with at least one overnight stay. With the selection criteria used, there may be no safety signal associated with same-day discharge.
Crawford et al[17]	2019	These authors analysed the incidence of complications associated with outpatient TKA and also the two-year minimum results. In 124 procedures, the patient stayed overnight for 23-hour observation. Thirty-seven (3.2%) were for convenience reasons and 87 (7.6%) for medical observation. Heart disease and chronic obstructive pulmonary disease were associated with increased risk of overnight stay. Excluding manipulations, reoperation within 90 days occurred in eight (0.7%) knees. Patients with two-year minimum follow-up had significant improvements in range of motion, Knee Society Clinical, Functional and Pain scores. Nine (0.8%) patients required revision. Manipulations were performed on 118 (10.3%) patients. The overall deep infection rate was 0.17% (2/1143).	Outpatient TKA is safe for a large proportion of patients. Certain medical comorbidities increase the risk of overnight stay. Patients had significant improvement in range of motion and outcome scores with low revision rate.

Note. NA, not available; UKA, unicompartmental knee arthroplasty; THA, total hip arthroplasty; TJA, total joint arthroplasty; SDD, same-day discharge; DOS, day of surgery; CCI, Charlson Comorbidity Index; ASA, American Society of Anesthesiologists; QoR, Quality of recovery; LOS, length of stay.

and the knee capsule. It has been shown that patients who receive a combination of adductor canal blockage and infiltration between the popliteal artery and the knee capsule have the best physical function just after the surgery and a lower length of stay compared with femoral nerve block.[32]

In a recent systematic review and meta-analysis, patients who received periarticular injections had lower pain scores, lower opioid intakes, higher ranges of movement at 24 hours and a shorter length of stay (LOS) than patients in the placebo or non-placebo injection groups.[33]

The loss of blood should be minimized to prevent possible complications that would delay discharge, such as anaemia, hypotension and a haematoma in the surgical wound. Tranexamic acid (TXA) can be administered systemically, topically or in combination. In a recent meta-analysis of 36 published studies (28 level 1), the combined use of intra-articular and intravenous TXA was associated

with a significantly greater reduction in blood loss than the isolated intravenous use of TXA.[34] In the knee, both the medial parapatellar approach and the quadriceps sparing approach have been used successfully.[18,35] In cases of outpatient TKA, the medial parapatellar approach has typically been used.

Postoperative considerations

In outpatient TKA a multimodal analgesia is advised. It consists of the administration of two or more drugs that act by different mechanisms for providing analgesia. The aim of multimodal analgesia is to improve pain relief while reducing opioid requirements and opioid-related adverse effects. Analgesic modalities currently available for postoperative pain control include acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and cyclooxygenase-2-(COX-2) inhibitors (Celecoxib).

The patient must be mobilized immediately after the motor component of spinal and regional anaesthesia has disappeared, ideally within two hours after surgery. The goal is to start physical therapy and mobilization for all patients after two hours. At two hours postoperatively, knee ROM exercises (flexion-extension) as well as active and passive knee exercises in bed must be initiated by a physiotherapist. Thus patients should bend the knee. Patients are mobilized in weight-bearing at six hours postoperatively. Before hospital discharge, they must have the ability to walk safely with two crutches, to walk on stairs, to perform home exercises and address their own personal needs, and to get at least 90° of knee flexion. A brace is not required. Then, patients are discharged home.

Patients should not show signs of delirium, nausea or vomiting; they must be able to evacuate (urinate) and maintain their vital signs without the need for intravenous fluids or oxygen. Upon hospital discharge, patients will be provided with oral thromboembolic prophylaxis, opioids, antiemetics, laxatives and non-steroidal anti-inflammatory drugs.[5]

The postoperative use of virtual digital technology in the form of smartphone or tablet applications is becoming increasingly important as an immediate follow-up system after discharge. It offers the possibility of awareness of the patient's pain, function and possible wound problems in real time. In addition, this technology can serve to remind patients of the medications they must take and the exercises they must perform.

Areas that require more research

Although outpatient TKA has proven to be safe, effective and cost-effective, additional research is needed in some key areas such as safety aspects.[4] A lack of universal criteria remains for patient selection. Outpatient TKA has been performed thus far in relatively young patients with few comorbidities. Although Gogineni et al have reported that predictors of successful SDD are duration of surgery and first ambulation distance, these parameters also require further research.[6]

A recent Danish prospective study found that 54% of patients ($n = 304$) were eligible for ambulatory THA or TKA according to the following inclusion criteria: consecutive 'unselected' patients with ASA < 3 and to be operated as number one or two in the operating room, and the presence of an adult at home for at least 24 hours after discharge.[4] Of these patients, however, only 28% and 24% of the THA and TKA patients, respectively, could be discharged on the day of surgery. It is important to mention that even in 'unselected' patients, SDD was feasible in about 15% of patients. Furthermore, it would interesting to know the reasons for not being discharged, as they are subjects that require more research, but this is not mentioned in the article. The main predictors of a lack of discharge on the day of surgery were female sex and the surgery being performed late in the day.

With the exception of the study by Goyal et al,[36] current evidence is based on comparisons of outpatient TKA versus inpatient TKA (level 4 of evidence).[9] Recently, Meneghini et al, on behalf of the American Association of Hip and Knee Surgeons, Hip Society, Knee Society, and the American Academy of Orthopedic Surgeons, stated that ambulatory surgery for THA and TKA has been successful over the last decade. The success obtained has been attributed to the coordination of the multidisciplinary team, standardized perioperative protocols, optimal planning of the hospital discharge and a careful selection of patients.[37] Table 2 summarizes the essential elements that need optimization for outpatient TKA.

Success of outpatient TKA requires a multidisciplinary approach that includes the following: (1) coordination of the multidisciplinary team; (2) careful selection of patients; (3) extensive preoperative patient education; (4) standardized perioperative protocols; (5) optimal planning of the hospital discharge; (6) upon hospital discharge, patients being provided with oral acetaminophen, NSAIDs, and COX-2 inhibitors (Celecoxib), thromboembolic prophylaxis, antiemetics, and laxatives. The main facts of the multidisciplinary approach are summarized in Table 3.[5,37–39]

Table 2. Important elements that need optimization for outpatient TKA

Patient selection
Preoperative 'school'
Family or professional outpatient support
Clinical and surgical team expertise
Institution facility or surgery centre factors
Protocols for pain management, blood conservation, wound management, mobilization and VTE prophylaxis

Note. TKA, total knee arthroplasty; VTE, venous thromboembolism.

Table 3. Success of outpatient total knee arthroplasty (TKA) requires a multidisciplinary approach that includes the following elements

Coordination of the multidisciplinary team
Careful selection of patients: Assessment of Ambulatory Arthroplasty Risk (AAAR) based on nine comorbidity areas is a better indicator to predict readmission than the American Society of Anesthesiologists (ASA) classification and the Charlson Comorbidity Index (CCI).
Extensive preoperative patient education: Once selected for outpatient TKA, the patient should be well informed about the procedure before surgery; the objective is to understand the expectations the patient has of the intervention.
Standardized perioperative protocols: Combined use of intra-articular and intravenous tranaexamic acid (TXA) is paramount to minimize blood loss; optimal control of nausea and pain; and early and intensive mobilization under supervision.
Optimal planning of the hospital discharge: Patients should not show signs of delirium, nausea or vomiting; they must be able to evacuate (urinate) and maintain their vital signs without the need for intravenous fluids or oxygen.
Upon hospital discharge, patients will be provided with: Oral acetaminophen, NSAIDs, COX-2 inhibitors (Celecoxib), thromboembolic prophylaxis, antiemetics, and laxatives. Then, patients are discharged home.

Note. NSAIDs, non-steroideal anti-inflammatory drugs; COX-2, cyclooxigenase-2.

Conclusions

Although there are no registries on outpatient TKA, in about 15% of unselected patients TKAs can be performed on an outpatient basis. Currently, approximately 5% of all TKAs are performed on an outpatient basis. Outpatient TKA (duration of hospital stay < 1 day) reduces costs by US$8,527, compared with patients admitted to the hospital for 3–4 days. Outpatient TKA has been reported to be a very successful, safe and cost-effective treatment in the management of advanced knee osteoarthritis. The success obtained has been attributed to the coordination of the multidisciplinary team, standardized perioperative protocols, optimal hospital discharge planning and a careful selection of patients. However, it is important to emphasize that outpatient TKA has been carried out thus far in relatively young patients, with few comorbidities (ASA < 3). Despite lacking universal criteria for the selection of patients, it is easy to understand that most of the 'common' patients seeking TKA would not be eligible without improved, dedicated pathways. Moreover, one study has shown a higher risk of perioperative surgical and medical results in outpatient than inpatient TKA, including component failure, surgical site infection, knee stiffness, and deep vein thrombosis. For these reasons, for now, it is not yet clear whether outpatient TKA is worth considering, except for relatively young patients without associated comorbidities, where the surgical indication for a TKA should be the last resort. Efforts should be made in keeping inpatient TKA safe but with a shorter stay for the vast majority of patients. The essential elements of an outpatient TKA are the following: minimizing complications, maximizing patient safety and discharging the patient to an appropriate and safe environment. Further research should evaluate safety issues.

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