

■ INSTRUCTIONAL REVIEW

The constraints on day-case total knee arthroplasty: the fastest fast track

E. Thienpont,
P. Lavand'homme,
H. Kehlet

From Catholic
University of
Louvain Cliniques
Universitaires St-Luc,
Brussels, Belgium

Total knee arthroplasty (TKA) is a major orthopaedic intervention. The length of a patient's stay has been progressively reduced with the introduction of enhanced recovery protocols: day-case surgery has become the ultimate challenge.

This narrative review shows the potential limitations of day-case TKA. These constraints may be social, linked to patient's comorbidities, or due to surgery-related adverse events (e.g. pain, post-operative nausea and vomiting, etc.).

Using patient stratification, tailored surgical techniques and multimodal opioid-sparing analgesia, day-case TKA might be achievable in a limited group of patients. The younger, male patient without comorbidities and with an excellent social network around him might be a candidate.

Demographic changes, effective recovery programmes and less invasive surgical techniques such as unicondylar knee arthroplasty, may increase the size of the group of potential day-case patients.

The cost reduction achieved by day-case TKA needs to be balanced against any increase in morbidity and mortality and the cost of advanced follow-up at a distance with new technology. These factors need to be evaluated before adopting this ultimate 'fast-track' approach.

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Total knee arthroplasty (TKA) has become one of the most frequently performed orthopaedic operations.¹ A combination of factors has caused this: 'baby-boomers' have remained active as they age and the results of TKA have improved. As the resources available for knee surgery are unlikely to increase, it becomes essential to improve the medical management of this group of patients and to reduce the incidence of less desirable events and complications.² It is as a result of this that 'fast-track' programmes have been developed in an attempt to enhance post-operative recovery, decrease morbidity and convalescence time and to shorten the length of hospital stay (LOS).³

Building on the experience of these enhanced recovery programmes, surgeons started to evaluate the concept of undertaking arthroplasty of the knee on a day-case basis.^{4–6} Apart from the financial incentives if the surgeon owns the surgical facility, the ultimate challenge for TKA would be to make the operation so straightforward that there were no barriers to surgery. The short stay would also lead to a substantial reduction in cost to society.⁶

In its advanced form, the reduction of medical comorbidity is all about stratification of risk and the identification, by pre-operative screening, of the individual problems of each patient.⁷ Since individual screening consumes time and resources, standardisation of patient care by means of 'clinical pathways' is advantageous for most hospitals.⁸

Based on 'Fast-track knee arthroplasty, status and future challenges',⁹ a review which highlights the major peri-operative factors that should be taken into account to optimise knee arthroplasty, as well as publications which consider barriers to the implementation of fast-track programmes,^{3,6} the authors consider the actual feasibility of day-case TKA.

The main question we address is whether a better understanding of the physiology of recovery and of different surgical and anaesthetic techniques can make it easier for patients to undergo TKA, and if optimising every step of the process would allow discharge on the day of surgery.

Overview of potential constraints

Some of the factors that affect discharge on the day of surgery can be influenced by preventive

■ E. Thienpont, MD, MBA,
Orthopaedic Surgeon,
Professor

■ P. Lavand'homme, MD, PhD,
Anaesthesiologist, Professor
Catholic University of Louvain
Cliniques Universitaires St-Luc,
Av Hippocrate 10, B-1200
Brussels, Belgium.

■ H. Kehlet, MD, PhD, Surgeon,
Professor, Section for Surgical
Pathophysiology 4074
Rigshospitalet, Blegdamsvej 9,
DK-2100 Copenhagen,
Denmark.

Correspondence should be sent
to Mr E. Thienpont; e-mail:
emmanuel.thienpont@
uclouvain.be

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Table I. Risk factors for patients unable to be discharged on the day of surgery

Risk factors	Reduced by pre-operative screening	Reduced by peri-operative treatment	Reduced by post-operative treatment
	Anaemia	Pain	Cognitive dysfunction
	VTE and PE	Bleeding	Orthostatic intolerance
	Muscle weakness	PONV	Comorbidity
	Social and organisational problems	Wound ooze	Mortality

VTE, venous thromboembolism; PE, pulmonary embolus; PONV, post-operative nausea and vomiting

care and pre-operative screening, some by peri-operative treatment and some by post-operative treatment. Others, however, are probably patient-specific and prevention currently seems difficult, if not impossible (Table I).

Risk factors reduced by pre-operative screening

Anaemia. Pre-operative anaemia is relatively common in patients awaiting TKA.^{10,11} The haemoglobin (Hb) level should be determined before surgery as should the cause of any anaemia.¹² In the absence of myelodysplasia, oral or intravenous (IV) iron treatment and erythropoietin may be given before surgery.¹³ A Hb level lower than 11 g/dL in women is predictive for transfusion after TKA, but not for unicompartmental knee arthroplasty (UKA).¹¹ Untreated anaemia increases the risk of post-operative transfusion and complications¹⁴ and prolongs LOS^{3,9,10} eliminating the possibility of same-day discharge.

Venous thromboembolic disease and pulmonary embolus. The reported symptomatic rate of deep vein thrombosis in hospital patients on the recommended venous thromboembolic (VTE) prophylaxis is 0.26% to 0.63%.¹⁵

The rate of inpatient pulmonary embolus (PE) is 0.14% to 0.4%, despite prophylaxis;^{15,16} prophylaxis with an extremely low rate of fatal PE (0.02%).¹⁷ Patients can be stratified into low- (0.35%), medium- (1.4%) and high-risk (9.3%) groups for PE.¹⁸

The risk of VTE has to be balanced against the risk of bleeding, especially in day-case patients. Aspirin may be effective for low-risk patients and warfarin/low molecular weight heparin (LMWH) preferred for high-risk patients.^{17,19} Intermittent pneumatic compression is no worse than chemical prophylaxis.²⁰ Patients who can walk need an intermittent compression device that is mobile.²¹ Patients stratified as high-risk should not be considered for day-case TKA because of the absence of post-operative medical supervision.

Muscle strength. Osteoarthritis of the knee is an inflammatory process which progresses with time: patients can reduce their pain by modifying their physical activity. The inflammatory process itself may also interfere with the quadriceps muscle.²² Therefore, patients often present with weak musculature.

Surgical approaches should be 'quadriceps-friendly' with minimal or no violation of the quadriceps mechanism.^{23,24} The far medial subvastus approach allows patients to walk

early after TKA without aids.²⁵ No difference in the strength of knee extension has been seen, whether or not a tourniquet is used.²⁶ Holm et al²⁷ found patients ready for discharge after a median of two days (IQR 1 to 4), the only independent predictor being the age of the patient. 'Prehabilitation' seems to reduce pre-operative pain²⁸ and increase the strength and function of the replaced knee in older adults²⁹ but its clinical impact and effect on same-day discharge is unknown.

Social and organisational constraints to hospital discharge. Pre-operative risk factors for a longer LOS are older age, female patients who live alone and have a limited walking distance and patients who have been taking opioids pre-operatively.³⁰ Constraints on returning home are difficulty with mobilisation and self-care tasks, social isolation and lack of support from family or friends, poverty and problems with the infrastructure of the patient's home.³¹ This group of patients should not be considered for day-case TKA.

Discharge home instead of to a rehabilitation facility may reduce the number of re-admissions.³² The re-admission rate after day-case TKA is 3.6%, both within a week of surgery and within three months.²⁴

Pre-operative patient education plays an important role in day-case TKA.^{24,33,34}

Risk factors during the peri-operative period

Anaesthesia. Old randomised studies and more recent big data suggest that spinal anaesthesia may be better than general anaesthesia.³⁵

Recent data which compare neuraxial blockade with modern general anaesthesia has not yet established which is better for day-case TKA.³⁶

Pain and peri-operative analgesia. Post-operative pain remains an important barrier to day-case surgery as it delays discharge from the hospital and has a major influence on the ability of the patient to resume normal activities at home.³⁷ Berger et al²⁴ observed that 6% of their day-case patients did not leave the hospital as planned because of inadequate pain control. TKA is a painful procedure: more than 50% of operated inpatients report moderate to severe pain in the first 72 hours after surgery.^{38,39} Predictive factors are female gender; younger age; severe chronic pre-operative pain from arthritis; the expectation of severe post-operative pain and the pre-operative use of opioids, anti-depressants or anti-convulsants.^{37,40,41} Both

pre-existing pain and the chronic ingestion of opioid analgesics may induce a state of enhanced nociceptive sensitivity called 'hyperalgesia' or 'sensitization'.^{42,43}

'State of the art' peri-operative pain management, which is needed for day-case TKA, currently includes both multimodal and preventive analgesia. Multimodal analgesia, the combination of more than one class of analgesic drugs, improves pain relief and, by its opioid-sparing effect, reduces the side-effects of opioids.³⁸ Preventive analgesia i.e. the extension of multimodal analgesia into the pre-operative and post-discharge period, is clearly better at controlling pain than pre-emptive analgesia,³⁸ particularly for day-case TKA. The best form of multimodal analgesia combines oral medication and local anaesthetics to reduce the need for parenteral drugs and to prevent peripheral sensitisation by neurogenic blockade.⁴⁴

A femoral nerve block (FNB), mostly as a single shot, remains very popular.⁴⁵ Its risk-benefit ratio has been questioned because of the risk of falls due to quadriceps paresis and residual posterior knee pain. The recent development of the adductor canal block (ACB) has stimulated interest as it is a more selective sensory block and may be an alternative to FNB.⁴⁵ The use of local infiltration analgesia (LIA) may be a significant advance.⁴⁶ It seems particularly effective for day-case TKA when combined with an ACB and oral analgesics.³⁶ The introduction of liposomal bupivacaine (Exparel, Pacira, San Diego, California) may extend the duration of local analgesia by up to two to three days, but to date published data have not supported this.⁴⁷ The intra-operative use of antihyperalgesic drugs like ketamine may improve the control of post-operative pain.⁴⁸ Gabapentinoids and ketamine also have opioid-sparing properties and can help to manage post-operative pain in opioid-dependent patients.^{48,49} Glucocorticoids are commonly used in low doses to prevent post-operative nausea and vomiting (PONV): in higher doses, they have not only an anti-inflammatory effect but also a pronounced analgesic effect.⁵⁰ Finally, opioids should only be used for breakthrough pain and before it becomes uncontrollable. Despite these techniques, a significant proportion of patients may still have pain, which will prevent discharge on the day of surgery.^{3,38} Patients with risk factors for severe pain should not be considered for day-case TKA.

Peri-operative bleeding and post-operative transfusion. A patient who is weak and has tachycardia because of significant blood loss will not leave hospital on the day of surgery. Waiting for a transfusion will immediately increase the LOS by a few days.^{3,10}

A blood loss management programme should include strict normothermia during anaesthesia⁵¹ and the use of either IV or topically-administered tranexamic acid.⁵²⁻⁵⁴ It is important to stem any bleeding from vessels such as the genicular arteries and femoral branches of the popliteal artery at the level of the posterior cruciate ligament.¹¹

Finally, maintaining the knee in flexion for a few hours after surgery may reduce the risk of haematoma.^{55,56}

PONV. Despite being a relatively minor medical problem, patients who suffer from PONV will not be fit to leave the hospital on the day of surgery. The Apfel PONV risk score⁵⁷ targets patients at high-risk but all patients for day-case TKA should have preventive treatment including opioid-sparing analgesia, intra-operative low-dose dexamethasone on induction of anaesthesia and a post-operative serotonin-receptor antagonist (ondansetron) if symptoms occur.

Wound leakage and dressing changes. Wound leakage and the need for dressing changes may require the patient to stay in the hospital. Wound leakage can be reduced by the use of a subvastus approach, LIA with adrenaline, and static exercises.^{58,59} Watertight closure of the arthrotomy with barbed sutures is recommended.⁶⁰ A tissue glue such as Dermabond (Ethicon, Connecticut) can be used to reduce oozing:⁶¹ when combined with modern wound dressings (Aquacel, Convatec, New Jersey) it reduces the need for immediate wound care.⁶² This silver-containing dressing reduces the risk of post-operative infection and the need for multiple dressing changes.⁶³ The choice of VTE prophylaxis plays a major role in the extent of wound drainage during the first days after surgery.^{17,19}

Poorly understood patient-specific risk factors

Post-operative cognitive dysfunction. Post-operative impairment of cognitive function may occur after any major surgical procedure, including TKA, especially in elderly patients and will delay discharge.⁶³ It is multifactorial: causes include reduced brain oxygenation during anaesthesia; post-operative pain and opioid use; bone marrow emboli; ion disturbances; urinary retention and the change of habitual environment.⁶³ Neuro-inflammation has been suggested to be the basis for this phenomenon.⁶⁴ The enrolment of patients in an enhanced recovery programme seems to have an effect on the problem making early cognitive dysfunction very rare and reducing, but not eliminating, the incidence of late cognitive dysfunction.⁶⁵ Prevention during the surgical procedure and control of the causative factors may reduce the problem.^{63,65}

Orthostatic intolerance. A significant group of patients present with symptoms of orthostatic intolerance after arthroplasty, particularly when they have to get up and walk for the first time.⁶⁶ No information is available about its incidence after TKA. No prevention or treatment is known, but the symptoms disappear with time. Further research should focus on the identification of patients at risk and their treatment when it occurs.^{3,67}

Comorbidity and mortality after TKA. The classic risk factors for a higher morbidity and prolonged LOS include old age; pre-existing cardio-pulmonary morbidity; smoking and alcohol misuse; the use of mobility aids and diseases such as diabetes. The exact role of these risk factors on day-case TKA remains to be established. Consequently, patients with an American Society of Anaesthesiologists (ASA)

grade of 3 and more, as well as patients needing specific medical care for their diabetes, hypertension or anticoagulation, should not be considered candidates for day-case TKA: nor should patients over 70 years of age.⁶⁸

Remaining challenges

Although considerable progress has been made over the last five to ten years in fast-tracking patients for TKA, there are still problems, particularly with day-case TKA. There is need for an improved understanding of specific pre-operative risk factors which may result in patients being entered into a different enhanced recovery programme with a potentially longer LOS, medical monitoring and physiotherapy.⁶⁹

Most of the morbidity seen after TKA is related to uncontrolled inflammatory responses of the body, reduced tissue perfusion and oxygenation, reactions to shifts in blood volume, thrombogenic reactions and central nervous system sensitisation. Besides better patient stratification and peri-operative medical treatment, the role of less invasive surgical techniques should be considered in the reduction of the 'surgical' effect on morbidity. It has been shown that C-reactive protein levels are lower after UKA than after TKA.⁷⁰ However, all these factors may be different for UKA^{4,5,24} because the surgery is less invasive and its impact on the physiology of the patient will differ⁷¹ with lower morbidity and mortality.^{72,73}

Finally, when considering day-case TKA there are two remaining issues. The first is where to discharge the patient - to their own home, a nursing facility or a rehabilitation centre.⁷⁴ The second issue, when patients return to their own home, is the cost of follow-up. This includes visits by nurses, 24-hour on-call physicians being available for questions and to deal with complications and the cost of new technologies to follow-up patients from a distance.

Currently, day-case TKA only seems possible for a very small group of patients (ASA 1 to 2, male, under 70 years of age). The clinical advantages and economies of this shorter stay will need to be convincing to offset the risks. The question that surgeons face is that of the shortest LOS after TKA which is entirely safe with the least risk of complications.

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H. Kehlet: Writing the paper.

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