Chapter 7

# Fast Track Surgery Program in Knee Replacement

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http://dx.doi.org/10.5772/intechopen.74026

**Abstract**

A Fast-track (FT) program, a well-established approach for patients undergoing selective operations, aims at enhanced post-operative recovery. It was first introduced by Professor Henrik Kehlet in 1990s and was applied in colorectal surgery. With the increasing elderly population as well as the increasing incidence of osteoarthritis, the rapid growth of requirement of joint arthroplasties is to be expected. Therefore, many orthopedic teams have applied related principles to their daily practice of total knee arthroplasty to accelerate rehabilitation with lower mortality and morbidity, and to optimize patient satisfaction. The program is a multimodal and multidisciplinary standardized care. Various caring specialties are involved to fulfill the goals of the fast-track program; the basic members include anesthetists, surgeons, pain specialist, physiotherapists, nurses and even medical physicians. In general, the strategy consists of five strands: careful patient selection, improving preoperative care, minimizing perioperative stresses, decreasing postoperative discomfort, and improving postoperative recovery. Through full understanding of these strands and concepts, a comprehensive, perioperative care is thus constructed. This review article gives reader an overall concept of fast track surgery in total knee replacement surgery. A comprehensive search in English literature, including case series, associate randomized controlled trials and systematic reviews were performed using the PubMed databases in 2017 December.

**Keywords:** fast-track, total knee arthroplasty, multimodal, enhanced recovery, perioperative care

## 1. Introduction

A Fast-track (FT) program, or more precisely named enhanced recovery after surgery (ERAS) is a well-established approach for patients undergoing selective operations that target enhanced

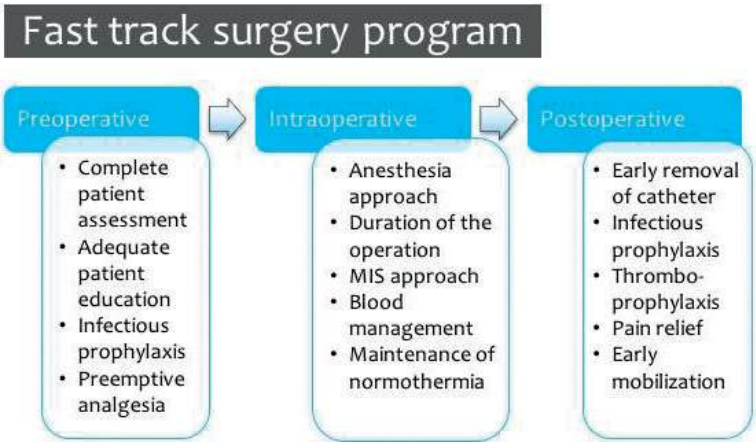


**Figure 1.** Algorithm of fast track TKA surgery.

post-operative recovery [1, 2]. FT refers to a standardized, evidence-base and multimodal strategy to surgery [3]. It aims at early recovery, early discharge with better prognosis and less complications. Outpatient surgical pathways even go one step further and aim for same day of admission and discharge of the patient undergoing selective operations.

This concept was pioneered by Professor Henrik Kehlet in the early 1990s and firstly applied in the colorectal surgery [4]. It is then expanded to many surgical fields, e.g., gynecologic, urologic, cardiovascular or orthopedic surgery. Over the past decades, it has been proven an effective and beneficial program for not only patients but also surgeons as well as the health insurance system.

As increasing elderly population and increasing incidence of osteoarthritis, the growth of requirement of knee arthroplasty is to be expected [5]. However, the difficulty in economic health care along with increasing financial pressure has reinforced the necessity of putting FT into the focus. An increasing number of knee surgeons have already introduced fast track surgery for patients undergoing knee arthroplasty. It is carried out by the fast track team which composed of anesthetists, surgeons, pain specialist, physiotherapists, and nurses [6].The main strategy consists of five strands: careful patient selection, improving preoperative care, minimizing perioperative stress, decreasing postoperative discomfort, and improving postoperative recovery, thus leading to potentially lower mortality and morbidity as well as optimizing patient satisfaction. To make the FT program and related approaches easily-understood, we classified it into 3 phases according to the proceeding of operation: the pre-, intra- and post-operative management. (**Figure 1**).

## 2. Preoperative management

The challenge for the patients begins with the initial consultation and the decision to undergo total knee arthroplasty (TKA). It is important to select appropriate candidates and optimize

every facet of their condition [7]. There are several key factors that should be considered to minimize the risks of complications and comorbidities [8].

### 2.1. Preoperative patient assessment

The preoperative assessment should always start with a thorough history taking. Patients often reported pain, functional deficit, or other instability symptoms. The location, duration, severity, character, alleviating and aggravating factors should be obtained in detail. The patients' baseline activity level and past medical history including underlying systemic disease, surgical history, anesthetic history, allergic history, social history and current medication should be recorded. Identification of the unfavorable conditions such as preoperative anemia or coagulopathy is important to reduce the potential complications and comorbidities. Also, previous surgical and non-surgical treatment should be documented. Patient's occupation, leisure hobbies and expectation toward surgical outcomes are inquired.

Complete physical examination is mandatory, including gait observation, inspection, palpation, measurement of range of motion, contractures and ligament stability. Gait observation is mainly looking for the presence of antalgic gait pattern and the requirement of walking aids. Inspection of the patients includes skin change, swelling, and associated deformity of the knee. Following palpation should identify the area of tenderness, severity of effusion, crepitus and patellar tracking. Measurement of range of motion, contractures and ligament stability are also needed.

### 2.2. Preoperative patient education

Adequate patient education is required to prevent patients or their family from holding unrealistic expectation. Surgeon should notify patients of what will happen during their inpatient stay, associated risks and the postoperative recovery plan. Some educational class illustrating the whole procedure and related impacts are therefore arranged for the candidates for TKA. In addition, the identification of assistive care companion at home is important to clarify the availability and ability of nursing after discharge, leading to the reduced anxiety of the patients for the coming surgical interventions. Through sufficient patient education and discussion, less anxiety with enhanced patient compliance could be expected [9].

### 2.3. Preoperative preparation

#### *2.3.1. Infectious prophylaxis*

One of the great challenge for orthopedic surgeon was avoiding the prosthetic joint-associated infections [10]. Several patients' preoperative conditions are considered as risk factors for increasing the rate of infection after TKA. Risk factors include old age, poor nutritional status, extreme body mass index, smoking, rheumatoid arthritis or diabetes mellitus [11–13]. Previous histories of trauma, steroid injection, or infection elsewhere in the body are also associated with increasing rates of infection. According to the Surgical Care Improvement Project initiated in 2004, rate of wound infections was reduced by the administration of prophylactic

antibiotics. Current literature suggested that systemic administration of prophylactic antibiotics should be given within 60 min of surgical incision [14].

*2.3.2. Preemptive analgesia*

Analgesia given prior to surgery is assumed to prevent peripheral and central sensitization. Preemptive medications such as NSAIDs, COX-2 inhibitors, and the neuropathic agent gabapentin and pregabalin have all shown promising result in reducing the magnitude and duration of postoperative pain [15]. However, the optimal dose, timing of administration, and whether there is potential benefit of continuing the analgesics during operation remain debating issues.

## 3. Intraoperative management

With the revolutionary advances in the surgical and anesthetic fields, many surgical procedures are now routinely performed on outpatient basis. Currently, with the combination of multiple strategies that target at minimizing surgical stress, many orthopedic surgeons are now applying the concepts of fast track program to their clinical practice. Fast track knee arthroplasty or even outpatient joint arthroplasty is increasingly performed. To reach the goal of fast track, there are 5 major strategies to be aware of: anesthesia approach, duration of the surgical procedure, minimally invasive surgical approach, blood management, and the maintenance of normothermia.

### 3.1. Anesthesia approach

The potential impact of different types of anesthetic technique administered during TKA on postoperative outcome remains controversial. Different anesthesia approaches may affect the incidence of surgical site infection, urinary retention, and also pose different impact on medical cost. There are two anesthetic techniques that are often used in TKA, general anesthesia and spinal anesthesia. In current literature, spinal anesthesia is a more recommended anesthetic approach as it is associated with more favorable postoperative outcomes, lower complication rate and lower 30-day mortality. Patients receiving spinal anesthesia are observed to experience shorter length of hospital stay, lower rate of pulmonary embolism, pneumonia, cerebrovascular events, acute renal failure and the need for blood transfusion [16, 17].

Regional anesthesia also plays a role in fast track program. Peripheral nerve blocks such as femoral nerve blocks and adductor canal blocks are often used in TKA in assistance with spinal or general anesthesia. It is assumed that peripheral nerve blocks provide supplemental anesthesia and analgesia effect during the perioperative and postoperative periods. Reported benefits include shorter length of hospital stay, less opioid consumption and earlier participation in physical therapy [18–20]. Reduced risk of hypotension and urinary retention were also observed in patients receiving regional anesthesia comparing with patients receiving epidural anesthesia.

Local infiltration anesthesia (LIA) has been gaining focus in recent years, as several well-conducted studies had indicated the potential benefits postoperatively [21, 22]. LIA consists of a

mixture of medications that include long-acting anesthetic, NSAIDs and epinephrine. Regimen varies from institution to institution. It is injected to the posterior capsule, collateral ligaments, capsular incision, quadriceps muscle tendon, and the adjacent subcutaneous tissues. Significant reduction in opioid consumption, improvement in pain VAS score and patient satisfaction are observed in patients receiving LIA [21, 22].

### 3.2. Duration of the surgical procedure

The duration of the surgical procedure should be minimized as short as possible. However, the delay in operation duration is frequently reported with revision surgeries, the use of computer navigation and inexperienced surgeons. Prolonged operative time may be highly associated with the increase rate of surgical site infection, deep wound infection and other associated complications [23].

### 3.3. Minimally invasive surgical approach

Minimally invasive approach for total knee arthroplasty was introduced in 1990s, and popularized in recent 10 years. The minimally invasive approach allowed smaller wound incision, less soft tissue trauma, less invasion to muscle, especially vastus medialis obliquus (VMO). Minimally invasive approach has transformed from conventional parapatellar approach, and later converted to sub-vastus approach, which boasted no invasion to VMO, and had less soft tissue damage during the procedure. However, with VMO preserved the surgical field clearance decrease and may lead to difficulties in prosthesis sizing, and placement. Mini-midvastus approach was then introduced, and was shown to have similar outcomes comparing to subvastus approach [24, 25].

Through minimal invasive approach, extensor muscles were maximally preserved. Large scale of RCTs showed the better short-term outcomes including better knee flexion/ extension torque, faster days to raise leg, greater range of motion, higher in knee society score (KSS), less total estimated blood loss and less postoperative pain [26, 27]. However, minimal invasive approach may also contribute to longer tourniquet time and operating time, as well as wound complication. In term of long term outcomes and longevity, there is still insufficient evidence to declare that minimal invasive approach had long term advantages over conventional total knee arthroplasty.

### 3.4. Blood management strategy

Perioperative blood loss of TKA can be significant. It could lead to resultant anemia which leads to further need of blood transfusion associated morbidity and mortality [28]. Therefore, it is always an important issue to avoid massive blood loss during and after TKA procedure.

During TKA, a pneumatic tourniquet is commonly used to provide clear surgical field and significantly reduces blood loss and surgical time [29]. However, no significant difference was shown for postoperative knee-extension strength, hemoglobin level, pain, nausea, length of hospital stay, and local swelling.

Antifibrinolytic agents such as tranexamic acid (TXA) decreased the rate of fibrinolysis and therefore stabilizes fibrosis clot [30]. It can be administrated by oral, intra-venous, intramuscular, or intra-articular. Current literature had shown the effect of reducing blood loss, less reduction of postoperative hemoglobin and less swelling with strong evidence [31–33]. In addition, there's no increased risk for deep vein thrombosis (DVT) among related studies.

### 3.5. Maintenance of normothermia

Maintenance of intraoperative normothermia (defined as a condition of normal core body temperature around 36.5 to 37.5°C) is recommended in current surgical guidelines (AHRQ, WHO, and SCIP) in order to minimize the incidence of complications. Although most surgical guidelines recommend maintaining patients in a normothermia status, the role is still controversial and unclear as these guidelines are often based on limited evidence outside the field of orthopedics. Several studies have suggested that perioperative hypothermia may increase perioperative blood loss, transfusion rate, risk of surgical site infection or the incidence of cardiovascular morbidities.

Patients who underwent general anesthesia or experienced longer operating time were at higher risk of who developing hypothermia. However, some studies showed the contrary result. Even though hypothermia increases the amount of estimated blood loss, it did not increase transfusion rate, postoperative complications, length of hospital stay or the rate of 30-day readmission [34]. In general, it is still recommended that patients' core temperature should be constantly monitored throughout the operation to maintain normothermia status.

## 4. Postoperative management

The goal of postoperative management is to enhance recovery and encourage patients to participate in physical rehabilitation soon after surgery. To optimize outcome and prognosis, multiple evidence-based principles of postoperative care are required.

### 4.1. Traditional care principles

Recent studies do not recommend the routine insertion of drain, nasogastric tube, or urinary catheter after surgery, as these tubes limit the patients to their early mobilization and ambulation [35].

### 4.2. Infectious prophylaxis

Postoperative prophylactic antibiotics are often used, but the duration was recommended no longer than 24 hours postoperatively [14].

### 4.3. Thromboprophylaxis

Patients who undergo TKA are at high risk of venous thromboembolism(VTE) as the incidence of symptomatic and asymptomatic VTE is 10% and 40–60%, respectively [36, 37]. After admission, a complete assessment of VTE risk is performed. Thromboprophylaxis measures include general, mechanical and pharmacological strategies. General thromboprophylaxis including avoidance of dehydration, early mobilization and lower limb range of motion exercises are applied to patients at any risk. Mechanical thromboprophylaxis including stockings or intermittent pneumatic calf compression are used during operation. While pharmacological strategies, for instance, low molecular weight heparins should be started 6 to 12 hours after surgery [38].

### 4.4. Pain relief

TKA is often associated with moderate to severe postoperative pain during the early postoperative period. Effective pain management following total knee arthroplasty is critical for which enables early mobilization, ambulation and even patients' satisfaction via the reduced adverse physiological and psychological responses [39, 40].

In traditional clinical practice, opiates play a major role in postoperative pain management. However, despite the strong analgesic effect of opiates, there are a number of associated adverse effects, e.g., nausea, vomiting, or risk of addiction. The associated adverse effects could further delay the recovery of the patients and increase the overall healthcare expenditure. Current literatures recommend the application of opioid sparing regimen with multimodal analgesics. It was proven to provide adequate pain control and avoidance of opioid-related adverse effects. Combination analgesics such as paracetamol, NSAIDs, COX-2 inhibitors, neuropathic medication or NMDA antagonist block different pathways of pain to optimize analgesic efficacy [41]. Combination therapy also reduces the required dose of individual medication which further lowers the incidence of medication adverse events. Other alternative modalities such as cryotherapy, through the application of cool water to the surgical site or transcutaneous electrical nerve stimulation (TENS) are also taken into consideration, as studies have shown to reduce the acute pain after surgery [42, 43].

### 4.5. Ambulation and exercise

Early ambulation and exercise should be valued as an important part of the fast track program as it provides a range of health benefits [44]. Current literature suggests that rehabilitation and physical therapy initiated on the day of surgery. Early mobilization potentially prevents complications such as venous thromboembolism, atelectasis, urinary tract infection, stroke,…, etc., [45]. Furthermore, it was reported by related studies to reduce length of hospital stay, post-operative morbidity and mortality, improved patient satisfaction, and reduced VTE and its sequelae [45, 46].

## 5. Authors' experience

As the most cost-effective surgical intervention for arthritic knee, TKA has become the daily practice of many orthopedic surgeons. Based on the supportive literature and our past experiences in establishment of clinical pathway, we believe the concepts and approaches of fast-track program (or enhanced recovery after surgery) are patient-friendly and practical. We found it a great idea to integrate various caring specialties to construct a comprehensive program throughout the perioperative duration.

Within a decade, we had shortened the length of stay of our patients from 12 days to less than a week using only part of the aforementioned recommendations in FT program, though more elder patients and unchanged criteria of discharge. In our institution, better recovery and satisfaction are to be expected after the completion of detailed preoperative education and evaluation.

## 6. Conclusion

In conclusion, fast track program represents a multimodal and multidisciplinary standardized care which aimed at early mobility, early discharge with better prognosis and less complications. By combination of preoperative, intraoperative, and postoperative strategies, the synergistic effects are shown to improve peri-operative outcomes. Decreasing length of hospital stay, complications, and overall medical costs can be expected. For a well-established surgical intervention as TKA, FT program provides benefits for the patients with their earlier recovery, early discharge with better prognosis and less complications. Further, the approaches of FT program will keep up with continued understanding of perioperative pathophysiology, improved care and evidence-based interventions.

## Acknowledgements

This work was supported by National Cheng Kung University Hospital (Grant number NCKUH-10609007) and National Cheng Kung University (Grant number NCKU-FD104008). We also acknowledge the technical assistance from Ms. Mei-Hui Shieh, and Yu-Chieh Chen.

## Conflict of interest

Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

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