

## Derleme

# Nursing and Practices That Speed up Healing in Heart Surgery

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### SUMMARY

Fast-track protocols are defined as practices, which speed up the healing process after operation. In heart surgery, practices such as minimally invasive surgical techniques, epidural and regional anesthesia are becoming popular. Practices such as optimal pain control, early extubation, mobilization, and nourishment, reducing the number of blood transfusions, maintenance of normothermia alleviate the surgical stress response, complications, length of hospital stay, and expenditures and speed up the healing process. Nowadays, fast-track protocols have been studied intensively in the heart surgery. The aim of this article is to collect the literature informatior, regarding practices, which speed up the healing process in the postoperative intensive care unit. Fast-track protocols represent a dynamic process, rather than standard practices which gives priority to patient's individuality and, requires continuous monitoring and evaluation. Creating team synergy is a factor, which will increase the applicability of multimodal approaches and the success of fast-track protocols.

**Key words:** *fast-track, nursing, intensive care, scoring systems, minimally invasive surgery, epidural anesthesia*

### ÖZET

**Kalp Cerrahisinde İyileşmeyi Hızlandıran Uygulamalar ve Hemşirelik**

Fast track protokolleri; cerrahi sonrası iyileşmeyi hızlandıran uygulamalar olarak tanımlanmaktadır. Kalp cerrahisinde minimal invaziv cerrahi teknikler, epidural ve bölgesel anestezi, yaygınlaşmaktadır. Optimal ağrı kontrolü, erken ekstübasyon, erken mobilizasyon, erken beslenme, kan transfüzyonlarının azaltılması, normoterminin sürdürülmesi gibi uygulamalar; cerrahi stres yanıtı, komplikasyonları, hastanede kalma süresini ve maliyetleri azaltmakta, iyileşmeyi hızlandırmaktadır. Günümüzde fast track protokolleri kalp cerrahisinde üzerinde yoğun çalışılan bir alan haline gelmiştir. Bu makalede kalp cerrahisi sonrasında yoğun bakımda iyileşmeyi hızlandıran uygulamalara ait literatür bilgilerinin derlenmesi amaçlanmıştır. Fast track protokolleri; standart uygulamalar yerine hastanın bireyselliğini ön plana çıkaran, sürekli izlemi ve değerlendirmeyi gerektiren dinamik bir süreci ifade eder. Ekip sinerjisinin sağlanması multimodal yaklaşımların uygulanabilirliğini ve fast track protokollerinin başarısını arttıracak bir unsurdur.

**Anahtar kelimeler:** *fast track, hemşirelik, yoğun bakım, skorlama sistemleri, minimal invaziv cerrahi, epidural anestezi*

### INTRODUCTION

“Fast-track” (FT) protocols are practices, which reduce postoperative complications, speed up healing process, reduce length of hospital stay and costs. For patients, who had undergone elective surgery, these protocols include approaches such as minimally in-

vasive surgical techniques, preference of epidural and regional anesthesia, reducing blood transfusions, maintenance of normothermia, optimal pain control, early extubation, early enteral nutrition and mobilization. Combination of these approaches reduces postoperative surgical stress response, dysfunctions and complications, and shortens the period for complete healing <sup>[1,2]</sup>. It has been stated that, invasive procedures, such as mechanical ventilation (MV), intubation, nasogastric tube, and urinary catheter applications increase mortality, the length of hospital stay and costs due to nosocomial sepsis <sup>[3]</sup>. It has been showed by recent studies, that traditional surgical care approaches, such as preoperative intestinal preparation,

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nasogastric tube application, long-term bed rest and special diet, were not needed or they were harmful [2,3]. The concept of FT has first been introduced by the Danish surgeon Henrik Kehlet and it was planned to be used in general surgery [1].

Application of FT protocols in heart surgery has become prevalent beside surgical techniques, which aim at reduction of incision and tissue damage, such as mini sternotomy, mini thoracotomy, endoscopic surgery, robotic surgery, by off-pump methods, which don't require cannulation, cardioplegia and open operations, and beating heart surgeries. Ultimate goal in heart surgery is one-day surgery. When application of FT protocols in heart surgery is compared with the traditional methods, it offers advantages such as accelerated healing, low complication rates, decrease in the length of hospital and intensive care unit stay and low cost. Thanks to these advantages, currently, fast-track protocols have been studied intensively in the heart surgery. It has been stated that, in the future, for accelerated postoperative healing, it will be necessary to combine evidence-based developments, integrated multi-modal methods and a multi-disciplinary approach, in which surgeons, anesthetists and nurses are involved [1,2]. Herein it has been aimed to collect literature information about the practices, which accelerate healing after heart surgery (Figure 1).

### Minimally Invasive Surgical Techniques

In heart surgery, previously, large cuts were made in order to explore the heart fully. Minimally invasive surgical techniques have been applied since 1990s [4]. Potential benefits of minimally invasive surgical techniques include decreases in postoperative pain, bleeding, operative and postoperative complications, scar formation, milder deterioration in body image, lesser stress on the immune system, reduced length of hospital, and intensive care unit stay, and lower medical expenditures. The use of one artery in coronary artery bypass surgery is preferred instead of using left anterior descending artery (LAD). In one research performed with 152 patients who had undergone minimally invasive surgeries, 30-day-mortality rate was 1.9%, and only 3.2% of the patients required revision surgery because of bleeding, while 95% of the patients did not receive blood transfusions, and 91.3% of them were extubated in the surgery room or

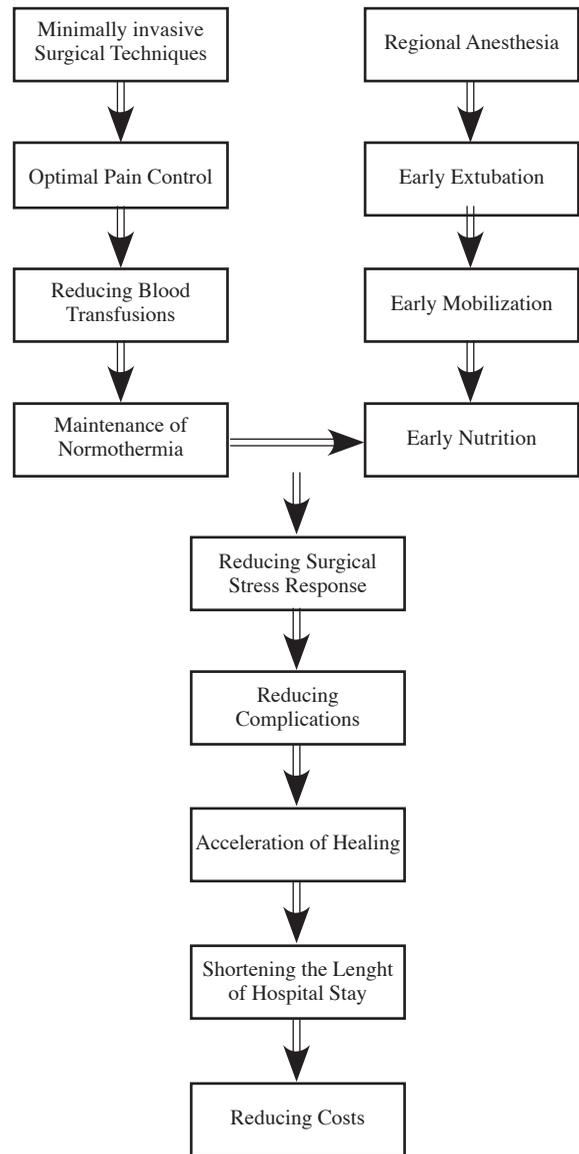


Figure 1. Practices, which accelerate healing in intensive care unit (fast track protocols).

on the day of surgery. Minimally invasive techniques are reliable for selected patients, who will undergo coronary artery bypass surgery [5]. It has been stated that, use of mini thoracotomy technique in mitral valve reoperation has some potential benefits including lesser intraoperative and postoperative bleeding [6]. In patients who are undergoing minimally invasive coronary artery bypass grafting (CABG) surgery by off-pump method, length of hospital stay will be shortened, feeding and mobilization could be achieved in shorter time [7]. In one study, where cases who had undergone on-pump (n=881), and off-pump

(n=885) CABG surgery were compared, off- pump method shortened intubation period, the length of intensive care unit and postoperative hospital stay and also reduced incidence of bleeding episodes, blood transfusion and hospital mortality rates Table 1<sup>[8]</sup>. Applications of minimally invasive surgical techniques confer advantages upon the patient's well-being and nursing care, besides their potential benefits.

**Table 1. Comparing off pump and on pump methods (Reser et al. 2014).**

	Off Pump method	On pump method
Intubation period (h)	5,8	7,4
Length of intensive care unit stay (day)	1,4	1,6
Length of postoperative hospital stay (day)	5,6	6,5
Total length of hospital stay (day)	8,8/day	9,7
Bleeding incidence (%)	1,7	3,3
Blood transfusion (%)	48,6	73,7
Hospital mortality (%)	1	2,7

## Regional Anesthesia

In heart surgery FT anesthesia is defined as a relatively shorter intubation period less than 5 hours<sup>[9]</sup>. In fast-track anesthesia; some strategies, which ensure early extubation, such as shorter duration of general anesthesia, minimal use of opioids and anesthetic medication, are applied as well as new anesthetic techniques<sup>[10]</sup>. While high thoracic epidural anesthesia and FT anesthesia are providing advantages against conventional anesthesia, awake surgery without intubation, ultra- FT anesthesia is less invasive, and it can be only carried out for selected patients. Application of high thoracic epidural anesthesia in heart surgery shortens intubation period, and reduces surgical stress. It is effective in pain management and provides some advantages such as glycemic control. But it has been stated in the literature, that this method carries a risk of epidural hematoma at the rate of 1-2%<sup>[11]</sup>. As stated in the literature, extremely shorter intensive care unit, (< 7.2 hrs) and hospital stay (5.1 days) were achieved in 129 patients with open conscious who had been operated by ultra- FT on pump method and thoracic epidural anesthesia without development of any low cardiac output syndrome, palsy, renal insufficiency and pulmonary dysfunction. Besides these patients felt less pain (VAS score= 3.3 pts)<sup>[12]</sup>. In one cohort study, to achieve FT healing,

thoracic epidural anesthesia was used in combination with general anesthesia which reduced 6-month mortality rate, and requirement for postoperative dialysis when compared with general anesthesia<sup>[13]</sup>.

## Early Extubation

It is described as extubation in the first five hours after FT anesthesia performed for heart surgery and it is stated that, early extubation is a determinative factor for the length of hospital stay<sup>[14]</sup>. High dose opioid is used in heart surgery in order to ensure hemodynamic stability. However in this case the patients need mechanical ventilation support (MV) before extubation. Besides, recovery is delayed, length of intensive care unit (ICU) and hospital stays are prolonged, operation costs are increased, patient circulation rate of the department is decreased. To avoid side effects of opioids, short-time utilization is a prerequisite for FT surgery. Low dose opioid utilization and interventions on the basis of general anesthesia decrease extubation period and shorten the intensive care unit stay<sup>[14,15]</sup>. It has been stated that, normothermic temperature management in FT anesthesia eases early extubation and it is needed for shortening the stay in ICU<sup>[16]</sup>. On-pump bypass operations with FT anesthesia can be used for most of the patients, shortening operation time and reducing blood loss are the key factors in successful early extubation for high-risk group<sup>[17]</sup>. It has been stated that, for the patients who were given fentanyl® and propofol® by infusion method, postoperative recovery, and total intubation periods are 1.3, and 4.3 hours, respectively. However if the patients are given traditional bolus doses then postoperative recovery, and total intubation periods are prolonged (3.3, and 7 hours, respectively). As noted in a study, any decrease in oxygen pressure and oxygen saturation and any increase in carbondioxide pressure were not observed in none of the patients in the infusion group who had received FT anesthesia and these patients didn't need to be intubated<sup>[18]</sup>. In one cohort study with a sample size of 7989 patients, any difference between FT, and conventional anesthesia in cardiac surgery regarding mortality and length of ICU and hospital stay, while FT anesthesia would decrease risk of renal insufficiency and myocardial ischemia<sup>[14]</sup>.

### **Early Mobilization**

Long-term immobilization brings about organ failure, sepsis, acidosis, neuromuscular drug toxicity, neuromuscular syndromes, delay in separation from MV, deterioration in life quality, prolongation of ICU stay, and increase in costs<sup>[19]</sup>. As reported in a study delirium, pressure ulcer, atelectasia, pneumonia, orthostatic hypotension and deep vein thrombosis can developed in ICU patients due to immobility<sup>[20]</sup>. Early mobilization can reduce mortality, morbidity, length of ICU stay and costs<sup>[20,21]</sup>. In one randomized controlled study with a sample size of 104 patients, a significant difference was found between early, and delayed mobilized groups, regarding delirium and length of ICU stay. Early mobilization can reduce delirium<sup>[21]</sup>.

### **Early Nutrition**

It has been demonstrated by studies that malnutrition in perioperative period reduces surgical tolerance and delays healing. According to the literature, average level malnutrition in patients, who had undergone heart surgery, is around 10-25 % and postoperatively developed malnutrition increases mortality and morbidity rates and prolongs the length of ICU stay<sup>[22]</sup>. Evidences in the literature suggest early enteral nutrition. Energy requirement in critical cases is 25-30 kcal/kg for electrolyte-fluid balance, and preventing malnutrition. Early enteral nutrition, provided within the first 24 hours after admission into ICU will decrease mortality rates significantly<sup>[23]</sup>. Despite its benefits, early enteral nutrition is accepted as a problematic issue for critical patients who have serious hemodynamic insufficiency. In one case series with seven patients, who received extracorporeal membrane oxygenation (ECMO) and in patients whose energy requirement was 25 kcal/kg, tolerance against enteral nutrition was ensured in the first week. Any side effects were not observed which could be attributed to enteral nutrition which was a safe nutritional strategy for patients, who had serious hemodynamic insufficiency and who received ECMO<sup>[24]</sup>. In one randomized controlled study with 1174 patients, who received MV and vasopressors, mortality and length of intensive care unit stay have been found to be shorter in the group who had received early nutrition in comparison with the group whose nutrition was delayed<sup>[25]</sup>. In one study conducted with 2312 patients

in seven centers, where parenteral nutrition was initiated within the first 48 hours (early nutrition) or on the 8th day (late nutrition), the authors found that, length of ICU and MV stay was shorter in the group with late parenteral nutrition<sup>[26]</sup>.

### **Alleviating pain**

The reasons of pain in heart surgery are large incisions, severe trauma and tissue destruction in large amounts, intubation, existence of catheters and chest tubes. Heart surgery is a stressful period for patients and this condition increases pain perception. Intensive pain is a strong stimulant for sympathetic nervous system. Heart rate and blood pressure can increase due to pain and increase in blood pressure can induce postoperative risk of bleeding caused by heparinization during the operation. Tachycardia and hypertension disrupts oxygen balance of the myocardium, and thus they may trigger development of arrhythmias, acute ischemia and cardiac insufficiency. It has been stated that, pain after heart surgery prolongs the length of ICU stay and increases the costs<sup>[27,28]</sup>. Besides, highly effective analgesia is needed for early extubation and for reducing the length of ICU stay and by using combined analgesia, side effects of both medicines can be reduced and stronger analgesia can be ensured<sup>[27]</sup>. Application of minimally invasive surgery reduces tissue destruction and pain, accelerates healing, shortens the length of intensive care unit stay. Pain control reduces surgical stress response<sup>[7]</sup>. Application of patient- controlled analgesia (PCA) and using intratechal low dose morphine® will reduce intravenous opioid consumption and early extubation can be ensured<sup>[15]</sup>.

### **Blood Transfusion**

In heart surgery, blood transfusion can be required. Because coagulation factors and platelets are consumed due to overactivation of hemostatic system, hemodilution, inflammation and mechanic effects of perfusion system. Anemia is frequent in the patients who were postoperatively taken into ICU. Besides, there is a positive correlation between postoperative hemoglobin level and mortality, length of ICU and hospital stay. Reduced hemoglobin level in the patients who were taken into ICU, results in insufficient oxygen supply and this cellular hypoxia in the

organs causes problems such as myocardial damage, increased demand for inotropic support, arrhythmia, neurological damage, palsy, renal dysfunction, increased number of postoperative dialysis sessions, and duration of MV application <sup>[29]</sup>. Despite rising need for blood and blood products, number of potential donors is decreasing, and costs of blood products increases in addition to aging in global population. Due to increased costs and religious reasons as seen in Jehovah's witnesses, use of autologous blood, and operations, performed without need for blood transfusions have become critically important. In one study, performed on 500 Jehovah's witness patients, who had undergone heart surgery without using blood, and blood products, mortality in the first postoperative 30 days was evaluated. It has been stated that, operations can be performed without using blood and risk of surgical mortality is equal with the operations performed by using blood <sup>[30,31]</sup>. It has been stated that, by use of minimally invasive techniques, such as mini sternotomy and mini thoracotomy, the incidence of intraoperative and postoperative bleeding were reduced <sup>[5,6]</sup>. In 95% of 152 cases, who had undergone coronary artery bypass surgery, there was no need for blood transfusion <sup>[5]</sup>.

### **Normothermia**

Body temperature is generally lowered by 2-4 °C, due to cold operating rooms, patients without being dressed and operating period, which lasts more than 2 hours. Thermoregulation is impaired during anesthesia in heart surgery. Mild hypothermia before cardiopulmonary bypass changes bioavailability of numerous medicines and reduces metabolism of narcotics and neuromuscular blocking agents. Postoperative shivering increases metabolic rate, causes myocardial ischemia and it has potential risks such as increase in the incidence of coagulopathies, and surgical wound infections. But hypothermia has some benefits, such as protecting cerebral ischemia from hypoxia. While maintenance of intraoperative normothermia is associated with decreased blood loss decreased rate of complications, cortisol and catecholamine are released in hypothermia. They increase tachycardia and nitrogen excretion during rewarming. Maintenance of postoperative normothermia can reduce stress of the process, somewhat prevents organ dysfunction, and shorten intubation period <sup>[32]</sup>. Maintenance of normo-

thermia after heart surgery has critical importance for successful extubation. Mild hypothermia (34°C) is optimal in that it successfully maintains a balance between risks and benefits for the patients, who are undergoing surgery under FT protocol. In one study, harmful effects of local cardiac hypothermia and cardiac normothermia techniques on myocardium were investigated in patients who had undergone CABG surgery and it has been stated that, there was statistically significant difference between 18-28°C deep hypothermia group and 34°C normothermia group and the values, measured from blood species, taken from coronary sinuses, as C3, C4, Troponin, tumor necrosis factor TNF - $\alpha$  were higher in the hypothermia group. It has been stated that, use of hot blood cardioplegia causes less myocardial damage in comparison with use of ice - cold blood cardioplegia and hypothermia during cardiopulmonary bypass <sup>[33]</sup>. Respiratory insufficiency and mortality in patients, who were applied deep hypothermia, were higher in comparison with normothermic patients <sup>[34]</sup>. It is important to maintain postoperative normothermia in order to minimize complications. Maintenance of normothermia during cardiopulmonary bypass will reduce the need for allogenic blood transfusion <sup>[35]</sup>.

### **Reducing Surgical Stress Response**

Application of FT protocols reduces surgical stress and accelerates healing. In one study, performed with 99 patients who had undergone abdominal aortic aneurysm operation, it was stated that, application of patient -controlled epidural analgesia, early postoperative nutrition and early mobilization without preoperative intestinal preparation and with a shortened fasting period, reduces development of systemic inflammatory response syndrome (SIRS) and organ failure <sup>[36]</sup>. It was also stated that, use of minimally extracorporeal circulation reduces mechanical ventilation period, length of intensive care unit stay, requirement for inotropic support, intraaortic balloon pump implantation, risk of postoperative atrial fibrillation and renal insufficiency development <sup>[37]</sup>.

### **Reducing Complications**

While off-pump method reduces complications such as systemic inflammation, myocardial damage and brain damage, it is also much more effective in re-

ducing minimally invasive surgical complications<sup>[38]</sup>. It has been stated that, it causes delirium in the ICU patients, mortality, and increases length of hospital stay, complications and medical costs. Postoperative delirium after cardiac surgery is related to various risk factors. Most important risk factors are age, depression, palsy, cognitive disorder, diabetes, prolonged intubation, type of surgery, blood transfusion, presence of inflammatory markers, increased plasma cortisol level and postoperative complications<sup>[39]</sup>. Application of FT protocols can reduce postoperative cognitive regression incidence. FT weaning protocols and sedation can reduce incidence of delirium in the patients who underwent cardiac surgery<sup>[40,41]</sup>.

### Acceleration of Healing

There is no general suggestion for being included in the FT program. It has been stated that, evaluation of cerebral oxygen saturation before heart surgery can be used for determining the patients who will get FT protocol application. Besides, advanced age and left ventricle dysfunction are determinants for the failure of FT protocols in the preoperative period in heart surgery<sup>[42,43]</sup>. It has been proved that, patients recover faster and they get back into normal life quicker by application of FT protocols. In a study, performed with 171 patients who were applied early extubation, early mobilization and atrial fibrillation prophylaxis, the patients could be discharged on the 4th and 5th postoperative days provided that earlier discharge didn't carry any risk of rehospitalization, and the patients met the discharge criteria such as being in sinus rhythm for 24 hours, being able to walk on the stairs without support and having normal intestinal function<sup>[44]</sup>. It has been found that quality of life of the patients operated under FT protocols, and hospitalized in ICU less than 8 hours was more satisfactory within the first postoperative month<sup>[45]</sup>.

### Estimating The Length of Hospital Stay

Use of risk measurement systems, which ensure estimating preoperative, intraoperative and postoperative results is becoming popular. By predicting the length of ICU stay, it can be possible to inform the patient, receive his/her approval, increase his /her compliance to treatment and satisfaction and estimate the costs. A special care program can be prepared for the patient

group, whose length of hospital stay can be predicted, studies on preventable risk factors can be intensified, and sourcing can be managed. Early-warning scores have been developed with the purpose of saving time for the necessary intervention by identifying the patient whose situation getting worse. Cardiac arrest and mortality can be predetermined by early-warning scores and worse outcomes can be reduced<sup>[46]</sup>. APACHE IV score is an important indicator for determining mortality rate in the ICUs and it can be used in determining treatment efficiency<sup>[47]</sup>. TISS-28 scoring system can be useful in estimating treatment costs, by measuring the workload of nurses and planning of nurses and other staff<sup>[48]</sup>. EuroSCORE is the most commonly used scoring system in coronary bypass surgery, mortality and length of ICU stay can be estimated based on the points calculated in the cardiac risk scoring system. EuroSCORE values > 5 can indicate the failure of FT protocol<sup>[49]</sup>. SPA (surgical procedure assessment) score is an easily applied reliable method in predicting the length of ICU stay and identifying the patients, who will be candidates for the application of fast-track protocol<sup>[50]</sup>.

### Shortening the Length of Intensive Care Unit Stay

Application of FT treatments after heart surgery has shortened the length of ICU stay considerably. Re-admission to ICU is accepted as a negative criteria. Failure criteria for FT treatments are as follows: lower ejection fraction (EF), need for blood transfusion, low cardiac output, renal insufficiency, revision surgery, shock, septic shock, palsy and deterioration in wound healing. ASA > 3 and operation time > 267 min are risk factors for the failure of FT treatments<sup>[51]</sup>. It has been stated that, readmission rates of FT applied patients into ICU differed according to the type of operation (readmission rates into ICU have been indicated as follows: CABG + valve operation, 5.5 %; valve operation, 4.5 %; CABG, 1.9 %) and all the readmitted patients had respiratory distress. In these patients ensuring liquid and blood equilibrium can be useful in preventing readmission into ICU<sup>[52]</sup>. Use of blood transfusions prolongs the length of ICU stay, but early extubation, mobilization, nutrition and application of less invasive interventions shortens the length of ICU stay<sup>[53]</sup>.

## Reducing Costs

One of the main purposes of FT protocols is more effective use of hospital resources without causing mortality and morbidity and reducing the costs. Postoperative complications and prolongation of hospital stay increase surgical costs. Reducing rates of readmission and enhancing nursing quality are important issues in the reduction of health costs. It has been stated that, regarding patients who had undergone CABG surgery, 30 % of the average expenditures was related to 34 factors including mortality in hospital, sepsis, use of extracorporeal membrane oxygenation (ECMO), permanent pace maker, and intracardiac defibrillator. Determination of the factors which increase costs, and also standardization of the sourcing have been recommended<sup>[54]</sup>. Medical expenditures were reduced for the patients who had undergone off-pump surgery by FT protocol which also didn't increase mortality<sup>[53]</sup>. In one study, performed with 94 consecutive patients in Japan, it has been found that, cost was reduced by half without any increase in complication rates in the group which received FT protocols<sup>[55]</sup>.

## The Nursing Care

Every component of the protocols that facilitate healing requires individualized care. Therefore, the nursing care should be planned individually. No matter what type of surgical approach is planned, the knowledge of the patient's treatment plan is an important requirement for the success of physiotherapy protocols. The most important aim in patient education is the awareness of an individual that he/she can take part in his/her own treatment decisions. The information about the duration of hospital stay, intensity of pain felt by the patients, exercise limitations in the postoperative period, and the nutrition plan should be obtained. The cosmetic concerns should also be relieved. The knowledge of the patient that he/she will be involved in the treatment plan will relieve the patient's anxiety and increase his/her compliance to treatment.

The new surgical techniques and evidence-based approaches have changed the classic procedures, and modified the goals of the nursing care. The goals of the nursing care cover all perioperative period from admission to discharge. The benefit of those indi-

vidualized protocols will include reduced need for analgesic use, low rate of incision site complications, shortened hospital stay and earlier return to one's daily activities. This fact have urged the nurses to apply protocols on early feeding, early mobilization, rehabilitation and patient education. The best contribution that the nurses can confer on the application of those protocols is the integration of the current literature to those protocols with strict obedience to the evidence-based approach<sup>[56]</sup>.

## Conclusion and Suggestions

Nowadays development in diagnosis and treatment methods ensures early recovery and reduces postoperative mortality and length of hospital stay. FT protocols represent a dynamic process, which emphasizes individuality of the patient and requires continuous monitoring and evaluation contrary to standard practices. ICU period can be shortened by continuous evaluation of benefits and risks. Ensuring team synergy is a factor, which may increase applicability of multimodal approaches and success of FT protocols. By monitoring and evaluating the patients continuously, nurses can contribute to effective use of sources, generalize the use of scoring systems, reduce complications, shorten the length of ICU stay, decrease mortality rates and costs. Nurses and nursing have great potentials in putting FT protocols into practice.

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