The Efficiency of the Patient Care Team on 3-Day Protocol for Early Ambulation after MIS-TKA

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Objective: *To evaluate the efficiency of the patient care team on the 3-day protocol for early ambulation after minimally invasive surgery-total knee arthroplasty (MIS-TKA)*
Material and Method: *A consecutive series of 120 episodes of patient's admission for MIS-TKA in 103 patients, who were taken care of by a single patient care team, was included in the present study. A uniform multimodal pain management and a 3-day rehabilitation protocol were applied. Patient's demographic data, co-morbidities, pre- and postoperative pain, and patient's voluntary early ambulation following the 3-day protocol were evaluated. Patients who accomplished the 3-day protocol were defined as having progress in postoperative ambulation, ability to do basic activities of daily living (ADL) and able to comfortably walk on postoperative day 3 (POD 3).*
Results: *Patient's mean age was 67.5 years and 68% (70/103) of patients had medical co-morbidities. After surgery, serial mean pain scores from six hours to the day of discharge in the studied group were < 3. The 3-day protocol had an overall success rate of 89% (107/120) regardless of medical co-morbidities. However, 32% of cases that had accomplished this protocol extended hospital stay due to non-medical reasons. Among 13 patients who were unable to accomplish the 3-day protocol, higher rate was found in patients who had > 1 medical co-morbidities. Comparing between unsuccessful and successful groups, there was a significantly increasing rate of unsuccessful protocol in patients who had > 1 medical co-morbidities (69.2% vs. 31.8%; p, < 0.05). There was no complication or readmission related to the early discharge program.*
Conclusion: *The result of 3-day protocol handled by the patient care team for MIS-TKA was highly efficient without complications related to early ambulation. However, this early ambulation protocol may not be appropriate for patients who have multiple medical co-morbidities. Besides the role of the patient care team, the efficiency of postoperative ambulation protocol was additionally relied on surgeon's experience in the surgical technique and effective multimodal postoperative pain control.*

Keywords: *Minimally invasive surgery, MIS, Total knee arthroplasty, TKA, Rehabilitation, Protocol, Early, Ambulation, Patient care team*

J Med Assoc Thai 2012; 95 (4): 537-43
Full text. e-Journal: *http://www.jmat.mat.or.th*

Total knee arthroplasty (TKA) has been accepted as the standard of treatment for debilitating arthritis of the knee since the introduction of the total condylar knee system in 1974[1,2]. Later on, minimally invasive surgery (MIS) for knee arthroplasty was introduced in the late 1990's. Based on Repicci's small incision in unicondylar knee arthroplasty (UKA), his idea encouraged further interest in the limited surgical approach in total knee arthroplasty[3,4]. In the year 2001, Tria and Coon[5] demonstrated successful results of minimally invasive-total knee arthroplasty (MIS-TKA). Since then, MIS-TKA has drawn attention from orthopedic surgeons worldwide. According to leading surgeons' experience in MIS arthroplasty, besides the MIS surgical technique, specific anesthetic method and postoperative pain control play important roles on the early postoperative ambulation of the minimally invasive hip and knee arthroplasties[6,7].

In Thailand, the senior author (AT) performed the first MIS TKA in October 2002 and reported the early experience on the first 22 knees with better clinical results than those underwent standard TKA (STD-TKA) in terms of wound size, blood loss,

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postoperative knee pain, timing of walking ambulation and length of hospital stay[8]. Following the authors' first series of MIS-TKA, in the second series on 114 TKAs[9], a multimodal postoperative pain control was introduced for MIS- TKA. After surgery, all patients were asked to voluntary sit, stand, and walk with a walker as soon as tolerated. Then, the discharge criteria were developed, including ability to flex the operated knee to 90 degrees and walking independently with a walking aid. According to the authors' first and second learning experiences in MIS-TKA surgical technique and experiences on postoperative patient ambulation after MIS-TKA, the comprehensive patient care team, including the surgeon, the anesthesiologist and ward nurses, has been developed, as well as a new postoperative ambulation protocol. During hospital admission, patients were taken care of by this comprehensive patient care team based on the 3-day protocol for MIS-TKA.

The purpose of the present study was to retrospectively evaluate the efficiency of the 3-day protocol for patient's early ambulation after MIS-TKA.

Material and Method

Between February 2004 and August 2007, 103 patients who had late stage of primary knee osteoarthritis and underwent MIS-TKAs at Saint Louis Hospital were retrospectively evaluated with approval of the institutional review board at our institute. Among 103 patients, 120 episodes of patient admission occurred in 122 MIS-TKA surgeries (17 patients had 2 admissions for staged bilateral TKA, and 2 patients had one-stage bilateral TKA). Patients with one-stage bilateral TKA were determined as a single episode of admission. As patients who underwent staged bilateral TKA had different severity of arthritis or leg alignment, different admissions with a minimum of 4-month interval and different results of blood tests, the authors considered these different admissions as different episodes of admission for MIS-TKA. Thus, a 120-cases group (120 episodes of admission) was determined as the study group for evaluation.

Surgical technique

All surgeries were performed by a single surgical team including anesthesiologist, internist, and surgeon. The single MIS-TKA surgical technique included a limited skin incision, minimal quadriceps tendon incision (2-cm tendon splitting), no patella eversion, and the use of a mobile skin window. The posterior stabilized knee implant (NexGen-Flex, Zimmer, Warsaw, IN, USA) was used in all knees. In all surgeries, a tourniquet was used and the knee was inserted with a vacuum drain before wound closure. The drain was removed at 12 to 14 hours after the surgery.

Anesthesia and postoperative pain management

Epidural analgesia was the primary selected method. Alternatively, for patients who had previous lower back surgery, the general anesthesia (GA) was used. Additionally, spinal anesthesia was added with morphine at a 0.2 to 0.3 mg/dose, only if there was a failed attempt for epidural analgesia. At the end of surgery, the epidural group received an additional epidural fentanyl at the dose of 1 μg/kg, while fentanyl at the dose of 1 μg/kg/hour was given intravenously for six hours in the GA group. For the spinal morphine group, no medication was added.

Following the multimodal postoperative pain control standing order, all patients received oral acetaminophen 1,000 mg every six hours for seven doses starting from six hours after surgery. Parecoxib sodium 40 mg was administered intravenously for three consecutive doses every 12 hours after skin closure, except those who had contraindications. Pain rescue medication was permitted at any time as requested by the patients. Patients in need of pain rescue medication received a 50 to 75 mg of parenteral tramadol every four to six hours as needed (50 mg/dose for patients with body weight < 70 kg and 75 mg/dose for patients with body weight > 70 kg). An intravenous drip of metoclopramide was administered for six hours in order to prevent nausea and vomiting.

Patient care team

Besides the surgery, anesthetic technique, and postoperative control, a comprehensive patient care team was developed. Four ward nurses, including PN, AY, NH, and PA, were instructed and rotationally assigned for patient evaluation and education. Patient evaluation was aimed to determine the patient's attitude regarding the MIS surgery in order to provide an appropriate holistic approach to the individual patient. Patient's education included details of the surgery, nursing care at the immediate postoperative period, the progress of postoperative ambulation, ambulation methods, muscles exercise, and steps to improve activities of daily living (ADL).

Postoperative ambulation and 3-day protocol

After surgery, clinical outcomes including pain score, ambulation, knee range of motion (ROM), and complications were evaluated from postoperative day 1 (POD 1) to POD 3 as the following:

POD 0: the day of surgery

After the hospital admission, one of three ward nurses, who were rotationally assigned for the patient care team, evaluated the patient for his attitude related to the surgery. Then, she educated the patient about the procedure of MIS-TKA, steps of surgery, benefits, and later clinical improvement, as well as postoperative ambulation, including how to do muscles exercise and ambulation with a walker.

After surgery, an effective immediate postoperative pain control was used. The patient was closely monitored for vital signs, intake-output, blood drainage, and side effects of analgesics. Additionally, the patient was encouraged to do active movement of the operated limb. Blood transfusion was administered based on the cutline of preoperative hematocrit level (<37%).

POD 1: the first day after surgery

Following the ability for appetite, the intravenous fluid was discontinued. The vacuum drain and the urinary catheters were removed. The assigned nurse asked the patient if he could do voluntary sitting with foot dangling, standing with full weight bearing, straight leg raising, and walking with a walker. The expected walking time on POD 1 was a minimum of 15 minutes/24 hour.

POD 2: the second day after surgery

The surgical wound was evaluated and wound dressing was performed. The operated limb was evaluated for swelling and other abnormalities. The patient was encouraged to continue ambulation, especially basic activities of daily living (ADL), including walking outside the patient room, climbing a few steps of stairs, and sitting in an arm, dining seat, and toilet seat. An expected total walking time was a minimum of 30 minutes/24 hour.

POD 3: the third day after surgery

The patient was evaluated for improvement of ADL. The satisfied improvement included comfortably walking with a walker, ability to flex the operated knee to 90°, no gross wound drainage, a minimum walking time of 60 minutes/24 hour, and no medical or surgical complications. The patient who accomplished the protocol was asked for being voluntary discharged from the hospital directly to home. The patient was discharged only if he agreed.

Statistical analysis

Statistical analysis was performed using GraphPad Prism version 5.01 for Windows (GraphPad Software, San Diego, CA, USA). Descriptive statistics (mean, range, standard deviation (SD) and percentage) were calculated for demographic and perioperative data, ambulation ability, and visual analog pain scores. The Chi-square test was made for percentage comparison between groups. P-value < 0.05 was considered statistically significant.

Results

Demographic data

Of the 103 patients enrolled into the present study, 90 were females and 13 were males. The average age $\pm$ SD at the time of surgery was 67.5 $\pm$ 7.8 years (range, 46-85 years). The mean Body Mass Index (BMI) $\pm$ SD was 27.5 $\pm$ 3.8. Sixty-eight percent of patients had medical co-morbidities, including hypertension, dyslipidemia, diabetes mellitus, coronary artery disease, hyperparathyroidism, hypothyroidism, chronic kidney disease, post-cerebovascular accident (stroke), asthma, chronic liver disease, and peptic ulcer. Of medical co-morbidities found in the studied group, hypertension was the most common co-morbidity, which was found in 38% (39/103) of patients. Numbers of medical co-morbidities in individual patients are presented in percentage were shown in Fig. 1. The mean preoperative knee range of motion (ROM) was 7.5-116.3°. In 120 cases (120 episodes of admission), the epidural anesthesia, the spinal anesthesia with morphine and the GA were provided in 93 cases, 20 cases, and seven cases, respectively. The mean total operative time $\pm$ SD was 105 $\pm$ 38 min. The average blood collected from the drain $\pm$ SD was 408 $\pm$ 292 ml. Mean baseline pain scores as measured on the VAS were 6.9 (range, 4-9).

Postoperative ambulation and clinical outcome

After surgery, serial mean pain scores of the studied group from 6 hours, 12 hours, 24 hours, 36 hours, and discharge were 2.5, 2.4, 2.2, 1.8, and 1.4 respectively (Fig. 2), of which unsatisfied pain relief was determined when pain score was ≥ 3. Among 120 episodes of admission, 89% (107/120) accomplished the 3-day protocol (Fig. 3). However, 68% (73/107) of

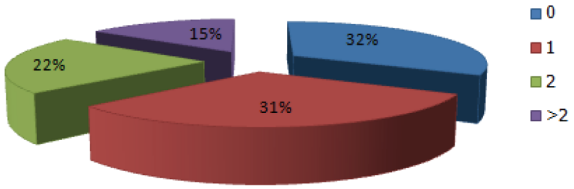

Fig. 1 Numbers of medical co-morbidities in studied group (n = 103) presented in percentage

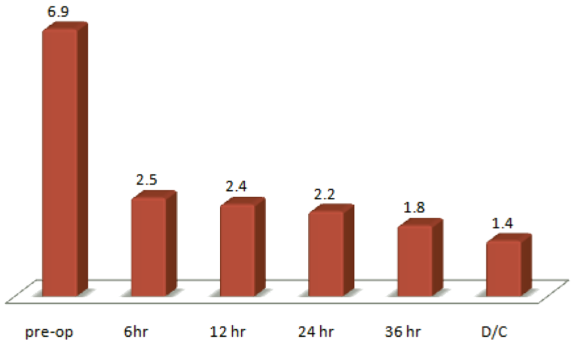

Fig. 2 Demonstrating mean pain scores from the pre-operative period to the postoperative period at 6 hours, 12 hours, 24 hours, 36 hours and at the day of discharge of the studied group

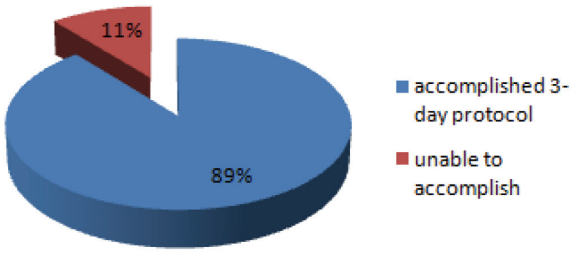

Fig. 3 Demonstrating percentages of patients who were able and unable to accomplish the 3-day protocol

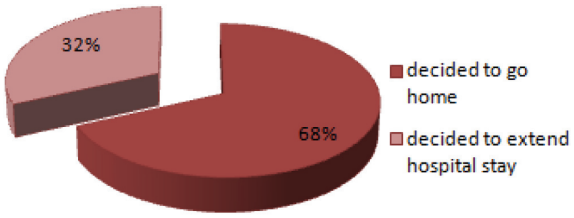

Fig. 4 Demonstrating percentages of hospital discharge on POD 3 in patients who accomplished the 3-day protocol

cases, that had accomplished the 3-day protocol, decided to go home (Fig. 4), while the rest (34/107) still chose to stay in the hospital. The reasons for those who extended the hospital stay were not related to medical issues, including waiting to be picked up by their family members, traditional belief on the lucky day of hospital discharge, and patient's preference to stay at the hospital.

Thirteen patients were unable to accomplish the 3-day protocol of which 11 (84.6%) had medical co-morbidities. Comparing the number of co-morbidity between patients who were able and unable to accomplish the 3-day protocol, those who had > 1 medical co-morbidities in the unable group had significantly higher percentage than the able group (69.2% vs. 31.8%; $p < 0.05$) as shown in Fig. 5.

There was no surgical complication or medical complication related to early ambulation. However, 10 cases developed slightly wound drainage from POD 2 and up to POD 5 days without any specific management and no further evidence of infection. At discharge, all patients went home with a self-rehabilitation educational program. No complication occurred during the 12-month follow-up period, as well as readmission for any reason.

Discussion

After the senior author introduced MIS-TKA in Thailand in 2002 and published the outcome of the first series of MIS-TKA in 2004[8], MIS-TKA has been among one of debatable issues in many Thai orthopedic meetings. Several controversial issues on results of MIS-TKA and STD-TKA related to early ambulation, postoperative knee pain, range of motion, blood loss, and patient satisfaction. According to the

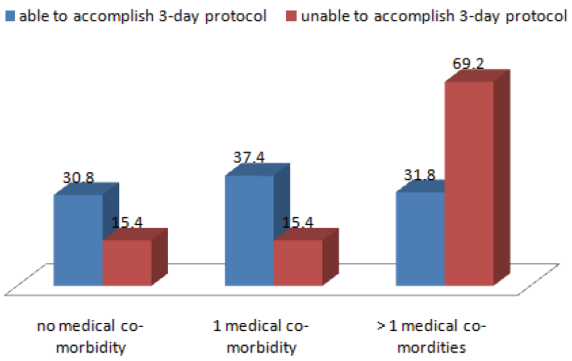

Fig. 5 Comparing the percentages of medical co-morbidities in patients who were able and unable to accomplish the 3-day protocol

authors' first MIS-TKA series, the learning experience in surgical technique was mandatory. Thus, early experience caused us more average operative time in the MIS-TKA group. In addition, the postoperative pain control was not well organized in that series. In the authors' second series in MIS-TKA[9], after passing the learning curve on surgical technique of MIS-TKA, the clinical outcomes were similar to the first report with less average operative time. In addition, the authors extended the MIS approach for TKA to variations of patient anatomical profiles, such as patellar baja, large bone in mediolateral projection, obese patients using the progressive quadriceps tendon incision technique[10].

According to the severity of postoperative pain after TKA and the side effect of narcotics used for pain relief, a multimodal postoperative pain management was proposed[11]. Following the early experience on comprehensive multimodal pain control in the authors' second series[9], the authors found this pain control option enhanced patient's ability to early ambulate and gained a consistent satisfactory results. In addition, patient functions were found to improve until discharge corresponding to the decreasing pain scores.

Several early ambulation protocols after MIS-TKA have been proposed in the literature[12-16]. The most aggressive early ambulation protocol was the out-patient MIS-TKA proposed by Berger et al[12], which started the patient's ambulation in a few hours after surgery and discharged patients on the same day of surgery. However, Berger et al[17] recently reported that there was a higher risk of patient's readmission following this protocol. On the other hand, many authors[13-16] proposed to ambulate the patient on the day after surgery and encouraged patient's early ambulation according to their specific protocols or clinical pathways after surgery, which resulted in a consistent immediate outcome. Recently, early patient ambulation and early patient's discharge after MIS-TKA became a standard practice in many institutions.

In the present study on 120 episodes of patient admission, the authors verified that combined the proper MIS-TKA surgical technique, the use of multimodal pain control regimen, and a well-organized patient care team provided an efficient 3-day protocol for early postoperative ambulation. The 3-day protocol had a success rate of 89% (73/107) regardless of medical co-morbidities, although 34 of 107 cases, that were able to accomplish the 3-day protocol, still insisted to extend their stay at the hospital, these patients did not have medical reasons to stay.

Regarding the number medical co-morbidities in TKA patients, the percentage of patients in the unable to accomplish 3-day protocol group who had > 1 medical co-morbidities was significantly higher than that in the able group. Based on voluntary early postoperative ambulation in the 3-day protocol, it implied that patients with more medical co-morbidities were less physically fit to early ambulate regardless of successful surgery and postoperative pain control. Thus, the surgeon and patient care team should not push these patients on early ambulation.

The limitation of the present study was that the study group was patients under the care of a single surgeon and patient care team, while another series may not have a similar outcome.

Conclusion

The use 3-day protocol provided by the comprehensive patient care team in MIS-TKA was highly efficient with the success rate of 89% and no complications related to early ambulation. However, this early ambulation protocol may not be appropriate for patients who have multiple medical co-morbidities. Besides the role of patient care team, the efficiency of postoperative ambulation protocol additionally relied on the surgeon's experience in surgical technique and effective multimodal postoperative pain control.

Potential conflicts of interest

None.

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ประสิทธิภาพของการดูแลผู้ป่วยเป็นคณะในการฟื้นฟูผู้ป่วยหลังการผ่าตัดเปลี่ยนข้อเข่าเทียมวิธีเนื้อเยื่อบาดเจ็บน้อย โดยใช้แผนการดูแล 3-day protocol

พรชนก นพคุณ, อัจฉรา ยินดี, เพียงเดือน อมรปิยะกฤษฐ์, นิภาพร เหล็กมั่น, อารี ตนาวลี

วัตถุประสงค์: *เพื่อประเมินผลประสิทธิภาพของการดูแลผู้ป่วยเป็นคณะ ในการฟื้นฟูผู้ป่วยหลังการผ่าตัดเปลี่ยนข้อเข่าเทียมวิธีเนื้อเยื่อบาดเจ็บน้อยโดยใช้แผนการดูแล 3-day protocol*

วัสดุและวิธีการ: *คณะผู้นิพนธ์เก็บข้อมูลจากผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมวิธีเนื้อเยื่อบาดเจ็บน้อย จำนวน 120 เข่า ซึ่งมีศัลยแพทย์คนเดียวกัน ซึ่งมีประสบการณ์ในการผ่าตัดวิธีนี้มาก่อน และคณะผู้ดูแลผู้ป่วยคณะเดียวกัน โดยใช้แผนการดูแลผู้ป่วยชนิด 3-day protocol ซึ่งมีวิธีควบคุมอาการปวดแบบ multimodal และวิธีการทำกายภาพรูปแบบเดียวกัน คือ เริ่มให้ผู้ป่วยนั่ง ยืน และเดินตั้งแต่เช้าวันรุ่งขึ้นหลังจากการผ่าตัด จนสามารถปฏิบัติภารกิจประจำวันขั้นพื้นฐานได้เองในวันที่ 3 หลังจากการผ่าตัด โดยได้เก็บข้อมูลของผู้ป่วย โรคประจำตัว ระดับอาการปวดของผู้ป่วยก่อนและหลังผ่าตัด รวมถึงติดตามประเมินผลของการฟื้นฟูผู้ป่วยตามแผนการดูแล 3-day protocol*

ผลการศึกษา: *ค่าเฉลี่ยของอายุผู้ป่วย คือ 67.5 ปี ร้อยละ 68 ของผู้ป่วยมีโรคทางอายุรกรรมมากกว่า 1 โรค ค่าเฉลี่ยของระดับความปวดหลังการผ่าตัด ตั้งแต่ 6 ชั่วโมงแรก จนถึงวันที่กลับบ้านในกลุ่มการศึกษานี้มีค่า < 3 การใช้ 3-day protocol ได้ผลสำเร็จร้อยละ 89 (107/120) ซึ่งร้อยละ 32 ของผู้ป่วยกลุ่มที่ได้ผลสำเร็จยังไม่ต้องการกลับบ้านจากเหตุผลที่ไม่เกี่ยวข้องกับการแพทย์ และร้อยละ 11 (13/120) ไม่ได้ผลสำเร็จจากการใช้ 3-day protocol เมื่อเปรียบเทียบระหว่างกลุ่มที่ได้ผลสำเร็จ และกลุ่มที่ไม่สำเร็จ อัตราการเกิดผลไม่สำเร็จเพิ่มขึ้นเมื่อผู้ป่วยมีโรคทางอายุรกรรมมากกว่า 1 โรค อย่างมีนัยสำคัญทางสถิติ (89.2% กับ 31.8%, $p < 0.05$) ในการศึกษาครั้งนี้ไม่มีผู้ป่วยที่เกิดภาวะแทรกซ้อน หรือ ต้องกลับมานอนโรงพยาบาลซ้ำ*

สรุป: *ผลการดูแลผู้ป่วยหลังการผ่าตัดข้อเข่าเทียมวิธีเนื้อเยื่อบาดเจ็บน้อยโดยใช้แผนการดูแล 3-day protocol มีประสิทธิภาพที่สูง และไม่พบภาวะแทรกซ้อนในการฟื้นฟูผู้ป่วย อย่างไรก็ตามในการฟื้นฟูผู้ป่วยตามแบบแผนนี้อาจไม่เหมาะสมกับผู้ป่วยที่มีโรคทางอายุรกรรมหลายโรค ทั้งนี้ประสบการณ์ความชำนาญในการผ่าตัดของศัลยแพทย์ การควบคุมอาการปวดให้เหมาะสมกับผู้ป่วยหลังผ่าตัด อาจมีความสัมพันธ์กับความสำเร็จในการดูแลผู้ป่วย*