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# Analysis of Factors Influencing Early Discharge in Patients Undergoing Knee Replacement Surgery Under the ERAS Protocol: A Single-Center Retrospective Cohort Study

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**Abstract**

To investigate independent factors influencing early discharge (hospital stay ≤3 days postoperatively) among patients undergoing primary unilateral total knee arthroplasty (TKA) under the Enhanced Recovery After Surgery (ERAS) pathway, a retrospective cohort study design was employed in which a total of 316 patients who underwent ERAS pathway TKA in the Department of Orthopedics, Deyang People's Hospital, a Grade A Class 3 hospital (the top tier hospital in mainland China) from January 1, 2024, to December 31, 2025, were consecutively enrolled. In this study, patients were divided into an early discharge group (n=142) and a conventional discharge group (n=174) based on whether patients' postoperative hospital stay was ≤3 days. Patient demographics, preoperative comorbidities and laboratory values, intraoperative data, and postoperative recovery indicators were all collected. Univariate analysis compared group differences, and statistically significant variables were included in a multivariate logistic regression model to identify independent factors influencing early discharge. Results showed: multivariate logistic regression analysis revealed that age <70 years (OR=2.41, 95% CI: 1.42-4.10), preoperative hemoglobin ≥130 g/L (OR=1.98, 95% CI: 1.18–3.33), intraoperative blood loss <100 ml (OR=2.85, 95% CI: 1.65–4.91), and those achieved ambulation within 24 hours postoperatively (OR=3.72, 95% CI: 2.14–6.48), and visual analog scale (VAS) score <4 on postoperative day 1 (OR=2.26, 95% CI: 1.31–3.89) were independent factors promoting early discharge. In conclusion: Under the ERAS pathway, early discharge in TKA patients is influenced by multiple factors. Optimizing preoperative patient status, refining surgical techniques to minimize trauma, and

enhancing postoperative pain management and early rehabilitation are key to achieving safe early discharge. Identifying these factors assists clinical care teams in conducting precise preoperative assessments and perioperative management.

**Keywords:** enhanced recovery after surgery, total knee arthroplasty, clinical care, length of hospital stay, influencing factors, retrospective study

## 1. Introduction & Literature Review

Total knee arthroplasty (TKA) is an effective treatment for end-stage knee osteoarthritis. Traditional perioperative management often involves prolonged hospital stays and elevated complication risks (Kehlet & Thienpont, 2013). The Enhanced Recovery After Surgery (ERAS) protocol employs evidence-based optimization measures to reduce surgical stress and accelerate recovery. ERAS management also improves knee function post-TKA and significantly reduces pulmonary infections and lower extremity venous thrombosis (Gao rui et al., 2024). For elderly TKA patients aged 70 years and above, ERAS improves postoperative pain and accelerates joint function recovery (Wang, 2025). One of its core objectives is to shorten hospital stays while ensuring safety (Ljungqvist et al., 2017). In recent years, “short-stay hospitalization” (≤3 days) or even “same-day surgery” after TKA has become a key outcome indicator pursued by ERAS (Boutros et al., 2025).

However, not all patients can successfully achieve early discharge. Premature discharge may increase readmission risks and patient insecurity (Hawke et al., 2019). Therefore, identifying factors that predict whether patients can safely achieve early discharge is crucial for implementing individualized, precision ERAS management. Existing studies have primarily focused on single factors, such as age or pain, lacking systematic analysis of factors across the entire preoperative, intraoperative, and postoperative continuum within the context of multimodal ERAS interventions (Frassanito et al., 2020). This study aims to systematically explore key factors influencing early discharge (≤3 days) in TKA patients under a mature ERAS pathway through a single-center retrospective cohort analysis, providing evidence for potential clinical care decision-making.

## 2. Research Methods

### *2.1 Study Design and Subjects*

This study is a single-center retrospective cohort study. Inclusion criteria were: (1) undergoing primary unilateral TKA in the orthopedic department of Deyang People's Hospital between January 1, 2024, and December 31, 2025; (2) age ≥18 years; (3) full adherence to the standardized TKA-ERAS pathway management established by this hospital. Exclusion criteria: (1) TKA performed due to infection, tumor, or fracture; (2) patients undergoing bilateral TKA or other major surgeries concurrently.

Patients were hence divided into two groups based on postoperative hospital stay (day 0 being the day of surgery): early discharge group (hospital stay ≤ 3 days) and conventional discharge group (hospital stay > 3 days).

*2.2 ERAS Protocol*

The hospital's standard TKA-ERAS pathway includes:

Preoperatively (multimodal nursing education, nutritional support and optimization, non-routine bowel preparation); Intraoperatively (spinal-epidural anesthesia combined with nerve blocks, minimally invasive surgical techniques, tranexamic acid administration, controlled hypotension, thermoregulation);

Postoperative (multimodal analgesia regimen [oral NSAIDs combined with obturator nerve block], antiemetic prophylaxis, oral intake initiation within 6 hours postoperatively, drainage tube removal within 24 hours postoperatively with encouragement of ambulation, standardized rehabilitation exercises).

*2.3 Data Collection*

The following data were collected via the electronic medical record system:

Demographic Data: Age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status classification.

Preoperative Status: Comorbidities (hypertension, diabetes, coronary artery disease), preoperative hemoglobin (Hb) and albumin (ALB) levels, preoperative Knee Society Score (KSS).

Intraoperative Status: Operative time, intraoperative blood loss, and tranexamic acid administration.

Postoperative recovery indicators: Time to first ambulation, resting VAS pain score on postoperative day 1 (0–10), postoperative complications (e.g., nausea/vomiting, dizziness, wound issues, deep vein thrombosis), and active knee flexion angle at discharge.

*2.4 Statistical Analysis*

Data analysis was performed using SPSS 26.0 software. Normally distributed quantitative data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and analyzed using independent samples t-tests. Non-normally distributed data were presented as median (M) and interquartile range (IQR) and analyzed using the Mann-Whitney U test. Categorical data were expressed as cases (%) and analyzed using the chi-square test or Fisher's exact test. Variables with $P < 0.1$ in univariate analysis were selected as candidates for inclusion in a multivariate binary logistic regression model (forward LR method) to identify independent factors influencing early discharge. Odds ratios (OR) and their 95% confidence intervals (CI) were calculated. $P < 0.05$ was considered statistically significant.

## 3. Study Results

*3.1 Patient Inclusion Process and Baseline Characteristics*

A total of 358 patients were initially screened, with 42 excluded for non-compliance with criteria, resulting in 316 final inclusions. Among these, 142 patients (44.9%) were assigned to

the early discharge group, and 174 patients (55.1%) to the conventional discharge group. No statistically significant differences existed between groups in gender, BMI, ASA classification, or major complications (P>0.05). However, the early discharge group exhibited younger age (P<0.001) and higher preoperative Hb levels (P=0.008). See Table 1.

Table 1. Comparison of Baseline Characteristics Between Early Discharge and Conventional Discharge Groups

| Variable | Early Discharge Group (n=142) | Conventional Discharge Group (n=174) | Statistic | *P* |
|---|---|---|---|---|
| Age (years, $\bar{x}\pm s$) | 66.8 ± 7.1 | 70.5 ± 8.3 | t=-4.243 | <0.001 |
| Female, n (%) | 98 (69.0) | 128 (73.6) | $\chi^2$=0.849 | 0.357 |
| BMI (kg/m², M (IQR)) | 26.1 (24.0-28.5) | 26.8 (24.3-29.1) | Z=-1.212 | 0.225 |
| ASA classification ≥ Grade III, n (%) | 31 (21.8) | 48 (27.6) | $\chi^2$=1.456 | 0.228 |
| Preoperative Hb (g/L, $\bar{x}\pm s$) | 135.2 ± 12.4 | 130.8 ± 14.1 | t=2.931 | 0.008 |
| Preoperative ALB (g/L, $\bar{x}\pm s$) | 39.5 ± 3.6 | 38.8 ± 3.9 | t=1.672 | 0.095 |

### *3.2 Comparison of Perioperative Indicators*

The early discharge group demonstrated significantly superior outcomes compared to the conventional discharge group in terms of intraoperative blood loss, time to first ambulation postoperatively, VAS score on postoperative day 1, and knee range of motion at discharge (P<0.05), as shown in Table 2.

Table 2. Comparison of Perioperative and Recovery Indicators Between Groups

| Variable | Early Discharge Group (n=142) | Conventional Discharge Group (n=174) | Statistic | *P* |
|---|---|---|---|---|
| Operative time (min, $\bar{x}\pm s$) | 88.5 ± 15.2 | 91.7 ± 17.8 | t=-1.754 | 0.080 |
| Intraoperative blood loss (ml, M(IQR)) | 80 (60-100) | 110 (80-150) | Z=-5.876 | <0.001 |
| First ambulation within 24 hours postoperatively, n (%) | 128 (90.1) | 105 (60.3) | $\chi^2$=36.921 | <0.001 |
| Postoperative day 1 VAS (points, M(IQR)) | 3 (2-4) | 4 (3-5) | Z=-5.112 | <0.001 |
| Knee flexion angle at discharge (°, $\bar{x}\pm s$) | 92.5 ± 10.3 | 87.2 ± 12.6 | t=4.130 | <0.001 |

### *3.3 Multivariate Logistic Regression Analysis of Factors Influencing Early Discharge*

Variables with P < 0.1 in univariate analysis (age, preoperative Hb, preoperative ALB, operative time, intraoperative blood loss, time to first ambulation postoperatively, VAS on postoperative day 1) were included in the multivariate logistic regression model. Results indicated that age <70 years, preoperative Hb ≥130 g/L, intraoperative blood loss <100 ml, ambulation within 24 hours postoperatively, and postoperative day 1 VAS <4 were independent predictors of early discharge. See Table 3 and Figure 1 below.

Table 3. Multivariate Logistic Regression Analysis of Factors Influencing Early Discharge in TKA Patients

| Influencing Factors | Reference Group | β | Wald $\chi^2$ | *P* | OR (95% CI) |
|---|---|---|---|---|---|
| Age <70 years | Age≥70 years | 0.880 | 10.258 | 0.001 | 2.41 (1.42-4.10) |
| Preoperative Hb ≥130 g/L | Preoperative Hb <130 g/L | 0.683 | 6.971 | 0.008 | 1.98 (1.18-3.33) |
| Intraoperative blood loss <100 ml | Intraoperative blood loss ≥100 ml | 1.047 | 14.376 | <0.001 | 2.85 (1.65-4.91) |
| Mobility within 24 hours | Mobility >24 hours | 1.314 | 22.054 | <0.001 | 3.72 (2.14-6.48) |
| Postoperative Day 1 VAS <4 points | Postoperative Day 1 VAS ≥4 points | 0.815 | 8.823 | 0.003 | 2.26 (1.31-3.89) |

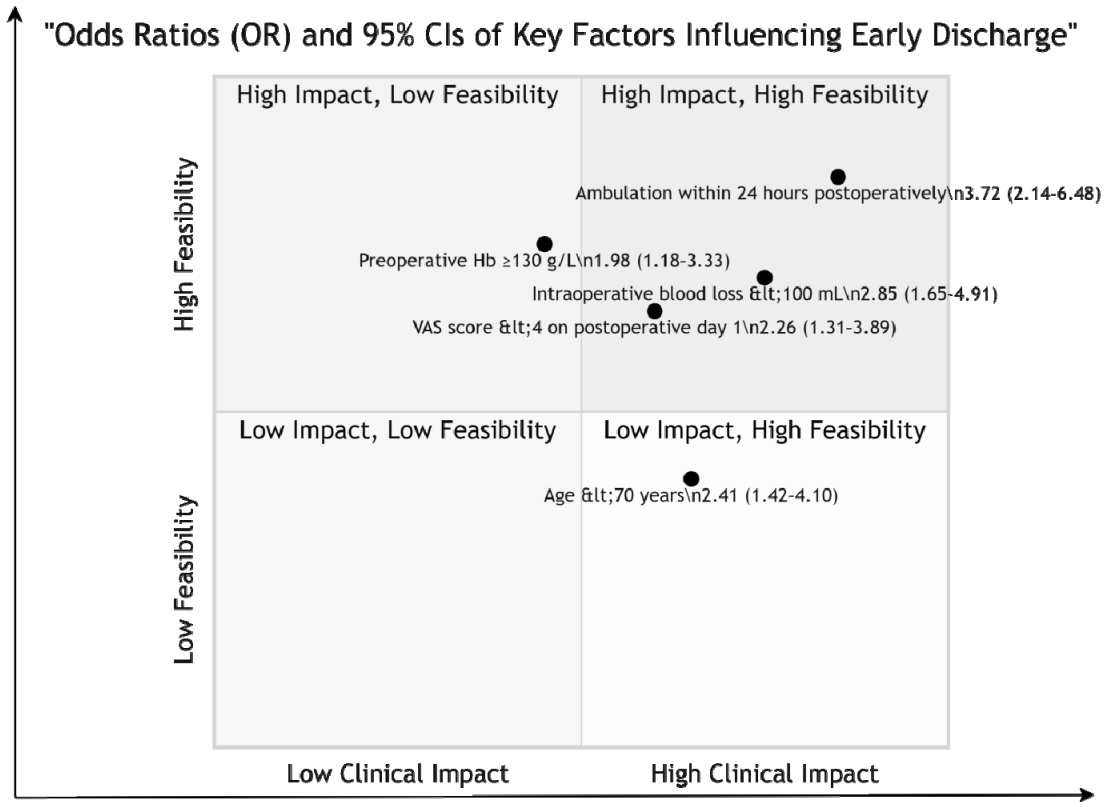


Figure 1. Odds Ratios (OR) and 95% Confidence Intervals (CI) for Key Factors Influencing Early Discharge

**Note:** The quadrant diagram illustrates five independent factors influencing early patient discharge, positioned based on their odds ratio (OR) values (clinical impact) and clinical feasibility. Each factor displays its OR value and 95% confidence interval. The first quadrant (upper right) represents factors with high clinical impact and high feasibility, making them optimal intervention targets.

## 4. Discussion

This systematic review analysis reveals that under standardized ERAS pathway management, approximately 45% of TKA patients achieved early discharge with postoperative hospital stays ≤3 days. Multivariate analysis identified five independent factors influencing this outcome, spanning three dimensions: patient baseline characteristics, surgical trauma control, and postoperative recovery efficacy.

First, the patient's physiological reserve serves as the foundation. Age is a classic predictor of postoperative recovery capacity. This study found that age <70 years was an independent factor for early discharge, consistent with the findings of Malviya et al. (2011). This may be related to older patients having more comorbidities, reduced physiological function, and greater fear of pain and activity. Additionally, preoperative hemoglobin levels (Hb ≥ 130 g/L), a key indicator of nutritional and oxygen supply capacity, demonstrated significant value in this study. Preoperative anemia is a major risk factor for TKA postoperative complications

and delayed discharge (Spahn, 2010). Our findings underscore the importance of strengthening preoperative anemia screening and correction within the ERAS pathway.

Furthermore, minimally invasive surgical techniques to reduce trauma are crucial. Intraoperative blood loss <100 ml emerged as a strong independent facilitator. This aligns closely with a core ERAS principle: minimizing surgical stress. Intraoperative blood loss is directly correlated with tissue trauma. Effective hemorrhage control—such as standardized tranexamic acid use (Fillingham et al., 2018) and meticulous surgical techniques—not only reduces transfusion requirements but also mitigates systemic inflammatory responses, thereby facilitating early rehabilitation (Kehlet & Wilmore, 2008).

Last but not least, postoperative recovery efficiency is a decisive factor, making nursing health education particularly crucial. Initiating ambulation within 24 hours postoperatively (OR=3.72) emerges as the most influential factor among all variables. The Consensus Statement on Enhanced Recovery After Surgery Nursing Care for Hip and Knee Arthroplasty recommends early postoperative mobilization to accelerate recovery (Wainwright, 2020). Early mobilization forms the foundation of the ERAS pathway, effectively preventing muscle atrophy, promoting gastrointestinal function recovery, and boosting patient confidence. Multiple studies confirm it as a key driver in shortening TKA postoperative hospital stays (Guerra et al., 2015). Concurrently, effective postoperative pain management (VAS < 4 on Day 1) is a prerequisite for achieving early mobilization (Karam et al., 2021). Multimodal analgesia protocols are central to achieving adequate pain relief, as poor pain control directly inhibits patients' willingness and ability to rehabilitate (Meneghini, 2021).

However, this study still possesses some inevitable limitations including its single-center retrospective design, which may introduce selection bias, necessitating caution when extrapolating conclusions. Future multicenter collaborative prospective studies are necessary and required for further validation and verification.

## 5. Conclusion

In the Enhanced Recovery After Surgery (ERAS) pathway, the ability of total knee arthroplasty (TKA) patients to achieve early discharge depends on the synergistic effects of multiple factors. The core of its management lies in: optimizing preoperative status (with particular emphasis on anemia correction), implementing minimally invasive techniques to reduce intraoperative blood loss, and systematically implementing postoperative rehabilitation measures, including effective pain management and early mobilization guidance. Clinical nursing teams should conduct individualized preoperative assessments and perioperative management around these modifiable factors to ensure the safety and success rate of early discharge.

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**Data availability statement**

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

**Data sharing statement**

No additional data are available.



**References**

Boutros, M., Nham, F. H., Corsi, M. P., Aoun, M., Lopez, J., Kassis, E., Daher, M., & El-Othmani, M. M. (2025). Bibliometric Analysis of Outpatient Hip and Knee Arthroplasty Research Evolution. . . *NUMBER, 13*(2).

Fillingham, Y. A., Ramkumar, D. B., Jevsevar, D. S., Yates, A. J., Bini, S. A., Clarke, H. D., … & Della Valle, C. J. (2018). Tranexamic Acid Use in Total Joint Arthroplasty: The Clinical Practice Guidelines Endorsed by the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy

of Orthopaedic Surgeons, Hip Society, and Knee Society. *The Journal of Arthroplasty, 33*(10), 3065–3069. https://doi.org/10.1016/j.arth.2018.08.002

Frassanito, L., Vergari, A., Nestorini, R., Cerulli, G., Placella, G., Pace, V., & Rossi, M. (2020). Enhanced recovery after surgery (ERAS) in hip and knee replacement surgery: Description of a multidisciplinary program to improve management of the patients undergoing major orthopedic surgery. *Musculoskeletal Surgery, 104*(1), 87–92. https://doi.org/10.1007/s12306-019-00603-4

Gao, R., Kang, D. S., Qin, H., Hu, Y. M., Chu T. W., & Dai, L. (2024). Meta-analysis of enhanced recovery surgery to improve pulmonary infection complications and outcomes after knee replacement. *Chinese Journal of Lung Diseases (Electronic Edition), 17*(2), 234–237. https://doi.org/10.3877/cma.j.issn.1674-6902.2024.02.012 (Original work published as Meta-analysis of enhanced recovery surgery to improve pulmonary infection complications and outcomes after knee replacement)

Guerra, M. L., Singh, P. J., & Taylor, N. F. (2015). Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: A systematic review. *Clinical Rehabilitation, 29*(9), 844–854. https://doi.org/10.1177/0269215514558641

Hawke, L. J., Shields, N., Dowsey, M. M., Choong, P. F. M., & Taylor, N. F. (2019). Physical activity levels after hip and knee joint replacement surgery: An observational study. *Clinical Rheumatology, 38*(3), 665–674. https://doi.org/10.1007/s10067-018-4317-6

Karam, J. A., Schwenk, E. S., & Parvizi, J. (2021). An Update on Multimodal Pain Management After Total Joint Arthroplasty. The Journal of Bone and Joint Surgery. *American Volume, 103*(17), 1652–1662. https://doi.org/10.2106/JBJS.19.01423

Kehlet, H., & Thienpont, E. (2013). Fast-track knee arthroplasty—Status and future challenges. *The Knee, 20* Suppl 1, S29-33. https://doi.org/10.1016/S0968-0160(13)70006-1

Kehlet, H., & Wilmore, D. W. (2008). Evidence-based surgical care and the evolution of fast-track surgery. *Annals of Surgery, 248*(2), 189–198. https://doi.org/10.1097/SLA.0b013e31817f2c1a

Ljungqvist, O., Scott, M., & Fearon, K. C. (2017). Enhanced Recovery After Surgery: A Review. *JAMA Surgery, 152*(3), 292–298. https://doi.org/10.1001/jamasurg.2016.4952

Malviya, A., Martin, K., Harper, I., Muller, S. D., Emmerson, K. P., Partington, P. F., & Reed, M. R. (2011). Enhanced recovery program for hip and knee replacement reduces death rate. *Acta Orthopaedica, 82*(5), 577–581. https://doi.org/10.3109/17453674.2011.618911

Meneghini, R. M. (2021). Editorial: Proceedings of the 2020 American Association of Hip and Knee Surgeons (AAHKS) Annual Meeting. *The Journal of Arthroplasty, 36*(7S), S1–S3. https://doi.org/10.1016/j.arth.2021.03.004

Spahn, D. R. (2010). Anemia and patient blood management in hip and knee surgery: A systematic review of the literature. *Anesthesiology, 113*(2), 482–495. https://doi.org/10.1097/ALN.0b013e3181e08e97

Wainwright, T. W. (2020). Consensus statement for perioperative care in total hip replacement and total knee replacement surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *Acta Orthopaedica, 91*(3), 363. https://doi.org/10.1080/17453674.2020.1724674

Wang, C. J. (2025, February 7). Analysis of the therapeutic effect of enhanced recovery after surgery for elderly patients with total knee arthroplasty. https://doi.org/10.16766/j.cnki.issn.1674-4152.003893