Enhance Recovery After Surgery (ERAS) for Total Knee Arthroplasty, the New Standard of Care, An Asian Perspective

Sheng Xu[1], Ming Han Lincoln Liow, Xuan Liu, Hee-Nee Pang[1], Darren Tay[2], Shi-lu Chia, Ngai-Nung Lo, Seng-Jin Yeo[3], Yongqiang Jerry Chen[4]
[1]Singapore General Hospital, [2]Department of Orthopaedic Surgery, Singapore General Hospital, [3]Singapore General Hosp, [4]Department of Orthopaedic Surgery

INTRODUCTION:
Total knee arthroplasty (TKA) is an effective treatment for end-stage osteoarthritis of the knee. With an increasingly aging population, the number of patients requiring TKA is expected to rise. Two of the most effective ways to reduce healthcare cost associated with TKA are to shorten the length of hospital stay and minimise post-operative complications. In recent years, there have been increasing interest in Enhanced Recovery After Surgery (ERAS) for TKA patients. As one of the first centres in Asia to introduce ERAS after TKA, this study aims to compare the early post-operative outcome of ERAS with non-ERAS TKA patients to justify and promote its adoption in Asia.

METHODS:
All patients who were eligible for ERAS TKA and underwent unilateral TKA from August 2020 to July 2021 were prospectively followed up. Knee Society Function Score (KSFS), Knee Society Knee Score (KSKS), Oxford Knee Score (OKS), and Physical (PCS) and Mental (MCS) component of Short Form 36 were assessed pre- and at 6-month post-operatively. ERAS TKA was done as day surgery, with patients discharging within 23 hours after surgery. The ERAS TKA protocol also comprised of: 1) review by physiotherapist for ambulation on same day after surgery; 2) home visit by physiotherapist at POD 1 week; and 3) home visit by nurse at POD 2 weeks. Patients who declined ERAS TKA protocol were admitted to hospital after surgery and discharged to either home when ready or to a step-down facility. All patients were followed up for 6-month and post-operative complications and re-admissions to hospital were recorded.
Functional outcome and quality of life score were compared between patients who underwent ERAS and non-ERAS TKA. Multiple regression was performed to adjust for confounding effect of pre-operative patient characteristics.

RESULTS:
738 patients underwent unilateral TKA and were included in the study, of which 342 underwent ERAS TKA and 396 underwent non-ERAS TKA (Table 1). Patients in the ERAS group were significantly younger and had lower Charlson Comorbidity Index (CCI) compared to the non-ERAS group. Patients in the ERAS group achieved significantly higher outcome scores than the non-ERAS group at 6-month post-operatively (Table 2). However, this is likely due the higher pre-operative outcome scores in the ERAS group as the improvement in scores from pre- to 6-months post-operatively were comparable between the 2 groups. After applying multiple regression to adjust for confounding effect of age, gender, CCI, and pre-operative scores, both groups had comparable improvement in all outcome scores (Table 3).
92.4% of patients in the ERAS group successfully completely the ERAS protocol and were discharged within 23 hours after surgery. The most common reason for failure to complete protocol were inadequate pain control (17.9%), patient decision to transfer to step-down facility (17.9%), post-operative nausea and vomiting (7.1%), and acute urinary retention (7.1%). The 30-days readmission rate for both groups were comparable (2.6% in ERAS, 2.5% in non-ERAS, p=0.928). There were 2 cases of prosthetic joint infection (PJI) requiring debridement, antibiotics, and implant retention (DAIR) and 2 cases of surgical site infection (SSI) requiring antibiotics treatment in the ERAS group compared to 1 case of PJI requiring DAIR and 2 cases of SSI in the non-ERAS group (p=0.357). There were no cases of 30-days mortality in either group.

DISCUSSION AND CONCLUSION:
The most important finding in this study is that patients who underwent ERAS TKA had similar functional and quality of life outcome improvement compared to non-ERAS patients with no increased complication rates. The median cost for ERAS TKA is $14,274 in the authors institution, compared to $17,120 for non-ERAS TKA. This translates to a 17% cost reduction among ERAS cases. Thus, ERAS TKA is a safe and cost-effective standard of care for TKA and its use should be   promoted.

Table 1. Patient demographics

	ERAS (n = 342)	Non-ERAS (n = 396)	p-value
Mean age, yrs (SD)	67.3 (7.1)	69.6 (7.6)	0.000*†
Male:female gender, n	123 : 219	111 : 285	0.021*‡
Mean Charlson Comorbidity Index (SD)	2.59 (1.1)	3.09 (1.3)	0.000*‡
Side of surgery, left:right	153 : 189	190 : 206	0.378‡
Body Mass Index, kg/m² (SD)	27.7 (4.7)	27.8 (4.9)	0.618†
Surgical duration, mins (SD)	89 (20)	93 (19)	0.003*

*Statistically significant
†Student's unpaired t-test
‡Chi-squared test
§Mann–Whitney U test

Table 2. Functional outcome and quality of life

Measurement	ERAS (n = 342)	Non-ERAS (n = 396)	p-value
Mean KSFS (SD)			
Preoperative	57 (17)	48 (21)	0.000†
6 months postoperative	75 (17)	65 (21)	0.000†
0 to 6 months postoperative	18 (20)	17 (23)	0.362
Mean KSKS (SD)			
Preoperative	39 (16)	36 (16)	0.005†
6 months postoperative	85 (14)	84 (15)	0.085
0 to 6 months postoperative	46 (21)	46 (22)	0.731
Mean OKS (SD)			
Preoperative	26 (8)	23 (8)	0.000†
6 months postoperative	40 (5)	39 (6)	0.001†
0 to 6 months postoperative	14 (8)	15 (9)	0.033†
Mean PCS (SD)			
Preoperative	34 (8)	32 (8)	0.000†
6 months postoperative	48 (9)	45 (10)	0.000†
0 to 6 months postoperative	14 (11)	13 (11)	0.613
Mean MCS (SD)			
Preoperative	55 (9)	53 (11)	0.007†
6 months postoperative	58 (9)	57 (9)	0.076
0 to 6 months postoperative	3 (11)	4 (11)	0.152

*Mann–Whitney U test
†Statistically significant

KSFS, Knee Society Function Score; KSKS, Knee Society Knee Score; OKS, Oxford Knee Score; SF-12, 12-Item Short-Form Health Survey; PCS, physical component score; MCS, mental component score

Table 3. Multiple regression adjusted for age, gender, Charlson Comorbidity Index (CCI), and pre-operative scores

Measurement	Est.B	95% CI	p-value
Mean KSFS (SD)			
6 months postoperative	-4	-8 to -1	0.005
0 to 6 months postoperative	-5	-7 to -1	0.005
Mean KSKS (SD)			
6 months postoperative	-2	-4 to 1	0.167
0 to 6 months postoperative	-2	-4 to 1	0.167
Mean OKS (SD)			
6 months postoperative	-1	-2 to 0	0.119
0 to 6 months postoperative	-1	-2 to 0	0.119
Mean PCS (SD)			
6 months postoperative	-2	-3 to 0	0.063
0 to 6 months postoperative	-2	-3 to 0	0.062
Mean MCS (SD)			
6 months postoperative	-0	-2 to 1	0.740
0 to 6 months postoperative	-0	-2 to 1	0.740

*Multiple regression using analysis of variance (ANOVA) model
†Statistically significant

Est.B, estimate beta coefficient; CI, confidence interval; KSFS, Knee Society Function Score; KSKS, Knee Society Knee Score; OKS, Oxford Knee Score; SF-12, 12-Item Short-Form Health Survey; PCS, physical component score; MCS, mental component score