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Viewpoint

Enhanced Recovery After Surgery: An Orthopedic Perspective

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Introduction

Enhanced recovery after surgery (ERAS) is an evidence-based, multidisciplinary, multimodal, and continuously audited approach to the care of the surgical patient [1,2]. Pioneered in 2001 for colorectal surgery [3], ERAS programs have since been developed and implemented for a variety of diseases and surgical procedures. In elective primary total joint arthroplasty (TJA), patients in ERAS pathways have been shown to have lower cost, mortality, and length of stay (LOS) with no subsequent increase in readmissions in comparison to non-ERAS cohorts [4–7]. Despite widespread adoption, many ERAS components lack strong evidence or effective auditing of compliance [8]. This viewpoint aims to identify the key elements of an ERAS protocol for TJA, to summarize available outcomes data, and to discuss the future of ERAS in the adult reconstruction domain.

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Body

In the early 2000s, a series of landmark publications by McGlynn et al. [9] and others following the Institute of Medicine's *To Err is Human* [10] reported on the failure of the US health-care system to safely and consistently deliver evidence-based, high-reliability care. Value-based care and alternative payment methods have since become increasingly prevalent [11]. In response, physicians and hospital systems have adopted interventions such as ERAS to reduce costs and complications. Despite financial incentives, orthopedic surgeon participation in Medicare's quality-based repayment models remains low [12]. Some surgeons may consider a 15- to 25-item ERAS protocol burdensome and lacking high-level specialty-specific evidence [13]. Given the variability in evidence among existing ERAS guidelines, it may benefit practices to simplify their ERAS protocols to the components that are supported near the top of the evidence hierarchy. This problem is being similarly addressed in other surgical specialties, in which a smaller number of ERAS components have been proposed as foundational [14]. It is important to consider which established ERAS components are most essential in the recovery of the patient undergoing TJA as the response to surgical stress from extremity surgery is clearly different than that seen with abdominal surgery [15–17]. With this in mind, we propose that preoperative optimization, multimodal opioid-sparing analgesia, transfusion avoidance, antimicrobial and antithrombotic prophylaxis, and early mobilization should form the core components of ERAS for the orthopedic patient (Table 1).

Preoperative optimization through a dedicated multidisciplinary clinic is a particularly effective means to reduce perioperative complications and improve patient outcomes. The evidence supporting smoking cessation [18], the diagnosis and management of diabetes [19,20], and the correction of anemia [21–23] is robust. Optimization of additional modifiable risk factors may provide further benefit; however, evidence in this area is still growing [24–26]. The use of multimodal opioid-sparing analgesia centered around nonsteroidal anti-inflammatory drugs and acetaminophen to reduce pain and opioid consumption is supported by strong [27] and moderate [28] evidence, respectively. Patient blood

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Table 1
Summary recommendation of foundational vs supplemental Enhanced recovery after surgery (ERAS) guidelines.

Preoperative	**Patient optimization**
	Smoking cessation
	Diabetes diagnosis and management
	Anemia diagnosis and management
	Additional modifiable risk factors
	Antibiotic prophylaxis
	Patient education
	Prolonged fasting avoidance
Intraoperative/Perioperative	**Patient blood management**
	Anemia correction
	Minimizing blood loss
	Restrictive transfusion thresholds
	Standardized anesthetic protocol
	Use of local infiltration analgesia in total knee arthroplasty
	Maintaining normothermia
	Perioperative fluid management
	Perioperative surgical factors
	Postoperative nausea and vomiting prophylaxis
Postoperative	**Multimodal opioid-sparing analgesia**
	Antithrombotic prophylaxis
	Early mobilization
	Early postoperative nutrition
	Criteria-based discharge
	Continuous improvement and audit

Bolding indicates foundational guidelines, or those that are supported by the strongest specialty-specific evidence.

management programs including diagnosing and managing preoperative anemia, using hemostatic agents (especially tranexamic acid), and restrictive transfusion thresholds reduce the risk of transfusion [29–31] and its associated complications such as periprosthetic joint infection [32]. Preoperative antibiotic prophylaxis is supported by strong evidence [33], and chemoprophylaxis against venous thromboembolism is supported by controversial, but moderate, evidence [34,35]. Finally, early mobilization has been shown to reduce LOS with strong evidence [36,37]. The aforementioned interventions should form the foundation for fast track or enhanced recovery programs after TJA as they are supported by the clearest specialty-specific evidence. Additional ERAS interventions including maintaining normothermia, perioperative fluid management programs, and modern standardized anesthetic techniques likely play an important role in influencing the recovery of the orthopedic patient, although the quality, consistency, and generalizability of existing evidence are limited.

Across the United States, advances in surgical technique and multidisciplinary care [38] have been shown to improve outcomes after elective TJA. The average hospital LOS in the United States after THA was 1.9 days, and it was just 1.0 day following TKA in 2020 [39]. Thirty- and 90-day readmission rates after THA are reported to be around 4% (95% confidence interval [CI], 4.2-4.5) and 8% (95% CI, 7.5-8.1), respectively, and those after TKA are 4% (95% CI, 3.8-4.0) and 7% (95% CI, 6.8-7.2), respectively [40]. Finally, 90-day risk-standardized complication rates after TJA are reported to range from 2.7% to 3.6% [41]. As primary elective TJA outcomes continue to improve, future ERAS research may include examining its impact on revision surgery as well as assessing measures of recovery that offer a more nuanced and multidimensional assessment of patient-focused outcomes, rather than one-dimensional, administratively focused outcomes such as LOS, readmission, or complication rates.

Conclusion

We are now more than 1 decade into the transition toward value-based care, and orthopedists have come a long way in delivering evidence-based standard of care processes to their patients. This is demonstrated by the continued, significant, and safe reduction in hospital LOS after TJA. Increased rigor in validating ERAS interventions remains crucially important to avoid losing progress through the addition of non–evidence-based interventions. To this end, we encourage fewer retrospective studies and recommend increased collaboration for multicenter prospective and randomized controlled trials that are adequately powered to measure the effects of complex interventions characteristic of ERAS pathways. Such studies have started to be published [42] and should encourage equally robust investigation for orthopedic surgery. Furthermore, the publication of helpful tools such as the Reporting on ERAS Compliance, Outcomes, and Elements Research (RECoVER) checklist [43] has made the accurate reporting of ERAS interventions easier. Advancements in continuous audit tools such as the ERAS Interactive Audit System benefit compliance, clinical outcomes, and cost-effectiveness [44] while facilitating the proper auditing and response to ERAS interventions; their development should also expand to include orthopedic surgery. Future integration of the electronic health record and development of livestreamed variance points will further aid pathway compliance. Additional improvements in quality may also be driven by the creation of a set of standardized composite data endpoints to track outcomes across the United States. Although we have come a long way in arthroplasty surgery toward the original ERAS goal of a patient-centered surgery that is “pain and risk-free,” there is more progress yet to be made.

Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: G. J. Golladay is the Arthroplasty Today Editor-in-Chief and received royalties and support from Orthosensor, Inc. M. J. Scott is the President of ERAS USA, Chair Education Committee ERAS Society, and received royalties and financial or material support from Elsevier for authoring a book.

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