

EDITORIALS

Enhanced recovery: joining the dots

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Eight years ago, we wrote an editorial for the *British Journal of Anaesthesia* exploring whether rapid, uncomplicated recovery after surgery would have downstream benefits other than just reduction in hospital length of stay (LOS).¹ At that time, the concept of Enhanced Recovery After Surgery (ERAS®) was more than 15 yr old (and had been practised under various names, such as fast-track surgery or accelerated recovery); yet, its uptake was initially sporadic. National implementation measures across the UK (such as NHS Improvement and the Enhanced Recovery Partnership) meant most hospitals and departments had adopted some form of a standardised care pathway by 2012. At that stage, established ERAS units recognised that there were very large potential gains to be had for patients undergoing major elective surgery. Many of the benefits arose from the evidenced-based, multimodal, multidisciplinary management of patients undergoing major surgery, creating a pathway that optimised patients preoperatively, minimised injury and stress at the time of surgery, and protocolised de-escalation of care to accelerate return of functional recovery. Here, we explore the evidence and developments in this field, why ERAS pathways have not been universally implemented, and their relevance in current healthcare during the coronavirus disease 2019 (COVID-19) pandemic.

A key driver of the implementation of ERAS across the UK was to release bed capacity, and therefore, the easy-to-measure endpoint LOS was historically used to compare and judge the success of ERAS programmes. Recording LOS still has merit; not least as remaining in a hospital environment is not risk free, and associated with fasting, sleep disturbance, immobilisation, infection, and medication errors.² However, measurement of LOS on its own is a somewhat limited metric for assessing the efficacy of patient-centred care, as there are other potential consequences for ERAS patients. Other areas have been studied and recorded in ERAS patients, including reduced pathophysiological responses with reduced organ dysfunction, quicker return of metabolic function, reduced complications and readmissions, improved cancer survival, reduced costs, improving patient satisfaction, and faster return to preoperative function.³ Moreover, with more than 10 million operations performed in the NHS annually and more than 300 million worldwide (with both rising annually),⁴ harnessing these potential gains for patients on ERAS pathways is enormous.

Since 2012, many of these proposed benefits have been realised, many from formal ERAS programmes. With good compliance to these programmes, not only does LOS decrease, but readmissions are usually reduced or unchanged, but not

increased, which is a valid concern when attempting to reduce LOS.⁵ Readmissions are a key area, as early hospital discharge without sufficient recovery can increase both patient and family anxiety, and increase the risk of hospital readmission. It is noteworthy that when readmissions do occur, they are associated with more challenging patients, such as ASA physical status of 3 or more, surgical complexity, and operation times in excess of 6 h in colorectal surgery,⁶ such that caution should be taken in the early discharge of patients identified at higher risk. A recent retrospective analysis has shown that greater use of enhanced recovery elements in hip or knee arthroplasty was associated with fewer complications and shorter LOS.⁷

Whilst reducing LOS and readmissions is important, it is the reduction in complications for surgical patients that is recognised as a key metric within healthcare systems, as it impacts on both short- and long-term outcomes.⁸ It has been estimated that all-cause postoperative deaths are the third biggest cause of mortality in the USA following heart disease and cancer.⁹ Non-fatal complications not only reduce patient satisfaction, but may impact patients permanently in terms of disability-free survival, functional recovery, and health-related quality of life, with an enormous associated socio-economic impact. ERAS pathways have consistently been shown to reduce complications, such as a surgical site infection and acute kidney injury, with strict pathway adherence promoting the greatest reduction in complications (both surgical and especially medical).³ A recent systematic review and meta-analysis of RCTs to examine perioperative prevention of postoperative pulmonary complications found that the most benefit was conferred by patients enrolled in ERAS pathways,¹⁰ rather than a single targeted respiratory intervention. ERAS also confers procedure-specific benefits; for example, in joint replacement surgery, it is possible to demonstrate reductions in a variety of common complications, such as postoperative delirium and cognitive dysfunction.¹¹ In another study of hip or knee arthroplasty, omission of venous thromboembolism (VTE) prophylaxis is proposed without apparently increasing the incidence of VTE and its complications.¹²

Early data supported the concept that colorectal cancer patients receiving an ERAS protocol may have improved disease-free survival,¹³ which is supported by more recent data from the same group showing that good adherence to the ERAS pathways (>70%) lowered the risk of 5 yr cancer-specific death by 42%.¹⁴ The factors involved are multifactorial and may include reduction of perioperative stress, preoperative nutrition, pre-habilitation, anaesthetic technique, reduction in complications, improved immune function with earlier commencement of other therapies (such as chemotherapy), etc.; a feature of such ERAS protocols is the difficulty in singling out the critical intervention(s).

ERAS has shown to be cost-effective in spite of the initial financial outlay (e.g. reorganising healthcare delivery, equipment, and training minimal access surgery). Data support sustained but varied reduction in costs (up to \$7000 per patient in direct cost),¹⁵ with a return on investment of \$3.8 (range \$2.4–\$5.1) for every \$1 invested in ERAS.¹⁶ However, even if LOS is reduced, it must be borne in mind that there may be significant post-discharge spending required for implementation.¹⁷ Some studies take this spending into account in their calculations, with the inclusion of primary care spending,¹⁶ whilst others appear not to.¹⁵

ERAS has spread to many other surgical specialties from the original four (colorectal, gynaecology, musculoskeletal,

and urology) to practically every surgical specialty, including cardiac, thoracic, neurological, vascular, paediatric, head and neck and bariatric surgery, and obstetrics,¹⁸ with others in development, such as spinal fusion surgery, vulvar and vaginal surgery, and cytoreductive surgery, with or without hyperthermic intraperitoneal chemotherapy. ERAS has also achieved marked successes in older patients.² The principles have also been applied to emergency general surgery,¹⁹ and there has been great success globally, not only for higher-income countries, but also for low- and middle-income countries.¹⁸ In spite of its many successes, ERAS still has a number of issues that need addressing in the future.

What do we understand by recovery?

A paradox encompasses the term ‘enhanced recovery’ inasmuch that the definition of what constitutes recovery after surgery is not universal. Only recently has due focus centred on this crucial area. Only as recently as 2015 have standardised outcome measures been defined and formalised in perioperative medicine.²⁰ Classically, recovery has been divided into three phases²¹ familiar to all anaesthetists: (i) restoration of biological and physiological parameters, such as adequate ventilation, BP, oxygen delivery (if measured), urine output (if measured) and more rarely used as guide to early patient management), and temperature in the postanaesthetic care unit; (ii) a symptom-based approach to recovery treating pain, gastrointestinal function, and the ability to perform basic activities before leaving hospital; and (iii) possibly most importantly and definitely the most neglected in the past, resumption of full functional activities and prior quality of life. This last area has been the subject of much interest, as it can take well more than 6 months for patients undergoing colorectal surgery to return to baseline physical capacity,²² and in the latest Perioperative Quality Improvement Programme (PQIP) report only 60% of patients resumed usual activities in this time frame.²³ There are many measures described for assessing these latter stages of recovery, including patient-reported outcomes and quality of recovery scores.²⁴ A useful, simple, and widely used measurement is ‘days at home up to 30 days after surgery’, a patient-centred outcome measure that is easy to measure and a useful marker of postoperative complications.^{25,26}

Which programme and pathway is right for my patient?

The advent of perioperative medicine pioneered at the Royal College of Anaesthetists embraces and complements many themes of ERAS. Perioperative medicine itself has driven improvements and led to other initiatives within the UK healthcare system. There are many common to the ERAS philosophy, including strict pathway adherence with no variation, and high-quality data collection, audit, and analysis to drive improvement. For example, the UK PQIP includes enhanced recovery within its ‘Top 5 National Improvement Priorities for 2019–20’,²³ and the concept of drinking, eating, and mobilising is very similar to ERAS principles.²⁷ However, ERAS differs from many perioperative programmes in the close involvement of many members of the perioperative team: primary care, surgeons, nurses, pharmacists, physiotherapists, dietitians, etc., in addition to anaesthetists.³ Although there is still substantial heterogeneity in ERAS protocols studied to date, pre-optimisation; injury and stress

reduction; rapid de-escalation; and transition to baseline preoperative functions of drinking, eating, mobilising, and sleeping are constant themes. Finally, the balance between individualised, patient-tailored medicine must be weighed against the value of standardisation of care characterised in ERAS pathways.

How many elements are in the pathway?

Although attempts have been made to standardise the writing of ERAS pathways²⁸ for different surgeries, research outcomes and pathway authorship have resulted in a large and varied number of required elements, often in excess of 20, that are seen as daunting.¹⁸ Many of these are now standards of care. This has generated a few practical issues concerning both attaining compliance and posing the question 'Which elements are really necessary?' Whilst it is recognised that compliance and outcome are closely related, analogous to a dose–response curve, it also recognised (and would be most unlikely) that not all components carry the same weight in terms of patient benefit.¹³ Moreover, some elements of care are covered in the WHO checklist (such as maintenance of euglycaemia, avoidance of hypothermia, and administration of antibiotics), whereas others are viewed as generic standards of care (such as avoiding fluid excess, ensuring multimodal analgesia, etc.). It is therefore logical that we direct focus to other major modifiable elements that confer the most benefits.

This area has recently been the subject of papers and editorials from which two major themes emerge. Firstly, the concepts described by Kehlet²⁹ more than 25 yr ago and reiterated in a recent editorial that re-emphasise his view that a return to the five early principles approach is required. This includes preoperative patient information, thoracic epidural anaesthesia in open (but not laparoscopic) colon surgery, avoidance of both fluid overload and hypovolaemia, avoidance of a nasogastric tube, and early oral feeding with mobilisation. In addition, there has recently been focus on the importance of postoperative elements, which, although often difficult to implement, are strongly associated with the greatest impact on optimal recovery. These include early removal or avoidance of urinary catheters, assistance with patient ambulation, and early feeding.³⁰

Why is ERAS implementation suboptimal?

A recurring theme within ERAS poses why there appear to be barriers to both implementation of and subsequent adherence to proven evidenced-based pathways. This concept, referred to as the 'knowing–doing gap', continues to be a major obstacle in delivering ERAS.³¹ These include patient, healthcare professional, and institutional barriers, with many reasons, such as ERAS programmes not meeting patient expectations and perspectives, issues related to medical and nursing staff (resistance to change, staff turnover and workload, and inadequate training and support) and institutional reasons, such as poor leadership, inadequate funding, and importantly a lack of good data collection that will in turn not allow reliable auditing and implementation of continuous feedback.³²

One issue that is seen as fundamental to benchmarking ERAS units and judging the success of ERAS as a whole is good-quality data collection. Contemporaneous good-quality data collection and analysis are required, which can then be benchmarked against other centres and compared over time. Where data are collected, such as ERAS Interactive Audit

System or PQIP (*vide supra*), valuable data are produced to drive change in the future, for example, in the form of a live dashboard or regular updates.^{23,33} With increasing adoption of standardised electronic patient records, there is the huge potential to harness outcome data across health systems to improve data collection and drive necessary outcome changes.

Research

The issue of conducting high-quality research in perioperative medicine is frustrated by a marked variation in practice between centres, often investigating several interventions within the ERAS elements.³⁴ This often results in losing any potential signal in improvement. The emphasis is thus moving towards much more tightly controlled patient-specific and procedure-specific interventions.³⁵ Moreover, the need for standardising patient-centred outcomes to facilitate comparison is viewed as fundamental in perioperative medicine trials.³⁶

The challenging patient

A number of patients do not fit the usual postoperative trajectory. Whilst much of ERAS focuses on procedure-specific issues, there are nevertheless patient-specific issues that will pose a clinical challenge, for example, an exaggerated stress response (both neuroendocrine and inflammatory). This area has been recently reviewed.³⁷ In particular, the neuroendocrine response, which is affected by the relative expression of glucocorticoid and mineralocorticoid receptors, determined genetically, can be further modified by illness, age, and deconditioning. These changes are associated with a number of common postoperative conditions, including cognitive dysfunction, myocardial injury, acute kidney injury, immunosuppression and infection, and muscle wasting, all of which will slow the expected progress of an ERAS patient.³⁷ Other patients include those who are receiving long-term high-dose opioid, or who are pain catastrophisers that will need their analgesic pathways planned and modified in advance.³⁴

Anaesthesia and ERAS

Our 2012 editorial¹ focused on a trimodal approach: analgesia, goal-directed fluid therapy (GDFT), and 'all the others'. At that time, analgesia and GDFT appeared to be pivotal in delivering ERAS; however, recent advances in these two areas have been modest: analgesia is delivered on a procedure-specific basis,³⁸ moving away from central neuraxial block (in spite of good early pain control) because of the associated problems of hypotension, immobility, and need for a urinary catheter. Although spinal anaesthesia can reduce LOS and modify the physiological response,^{39,40} many are now using more peripherally sited blocks, combined with regularly administered multimodal analgesia. Similarly, whilst fluid balance endpoints are agreed, avoiding too little or too much fluid administration (with patients at highest risk and least cardiac reserve probably benefiting the most), the optimal way of delivering this endpoint is still debated. It seems likely that timing of fluid administration is as crucial as the volume administered. Recent evidence from the FEDORA trial suggests that using goal-directed haemodynamic therapy for low- to moderate-risk patients undergoing intermediate risk surgery reduces complications and LOS, even if it does not reduce overall mortality.⁴¹ Overall, many patients arrive relatively euvoalaemic for theatre because of carbohydrate loading,

reduced fasting, and reduced need for bowel preparation, and thus, the main aims are to replace ongoing requirements and losses. Recent studies have also shown the importance of maintaining perfusion pressure and optimizing flow.⁴²

Although other intraoperative interventions have produced some encouraging results, such as total intravenous anaesthesia (in an attempt to reduce long-term cancer recurrence),⁴³ deep neuromuscular block (to allow reduction in intra-abdominal pressures during minimally invasive surgery), and opioid-free anaesthesia (to reduce postoperative nausea and vomiting), they have yet to find a clear, evidence-based established place. An area of practice that requires renewed attention is ensuring that neuromuscular block is adequately reversed at the end of surgery, as the incidence is of postoperative residual curarisation and the associated sequelae are still high, although it is reduced by the use of quantitative neuromuscular monitoring.⁴⁴ The focus for perioperative physicians will direct attention to other areas, such as patient blood management, nutrition, pre-habilitation, and glycaemic control, to early recognition and management of postoperative organ dysfunction and perioperative opioid stewardship (to minimise risks of opioid-related harm).

Coronavirus disease 2019

The current COVID-19 pandemic has significantly reduced our ability to carry out major elective surgery. With reduced operating theatre capacity and bed availability, together with inevitable financial constraints that will face global economies, the scenario is set for ERAS to flourish, delivering high-quality care at reduced costs. In addition, early discharge may well reduce COVID-19 infection risk (from nosocomial and staff transmission). Some aspects of the ERAS pathway may have to be delivered remotely (such as preoperative and postoperative consultations and advice), the emphasis must be on delivering high-quality care (including minimal access surgery where appropriate), all conducted in a safe environment of patient testing, isolation, and optimal personal protective equipment.

Joining the dots

So, how do we join the dots for the future? If the benefits outlined here from ERAS were a single intervention, such as a drug or a procedure, ERAS would represent probably the biggest advance in medicine for years, and its implementation would be mandated. ERAS does not make bad surgery good, but it does make good surgery optimal. Yet, for a multistep pathway, there will always be the temptation to bypass many of the elements, hoping for the same benefits. The future of ERAS lies perhaps not so much in tweaks to existing clinical pathways, but rather in more strategic concepts:

- (i) Defining what endpoint(s) constitute recovery
- (ii) Instituting, optimising, and maintaining ERAS programmes in different specialties and healthcare systems
- (iii) Producing the best-quality research and other clinical evidence to direct simplified and the most important clinical care pathways, with a focus on patient-centred outcomes
- (iv) Producing the best-quality contemporaneous institutional outcome data to allow benchmarking, the incidence of complications (e.g. via use of dashboards) thus rapidly directing local changes in practice where unwanted variation in best practice occurs

- (v) Recognition by healthcare funders of the importance of optimal perioperative care, and their engagement in future planning

Leaders of ERAS programmes must work with patients, managers, and healthcare funders to promote the importance of delivering optimal, evidence-based, and continuously audited care for all patients undergoing major surgery. To date, many dots have already been joined to create Kehlet's⁴⁵ goal of 'pain and risk-free operation', but it is not yet a continuous line, so we should not put away our pencils.

Declarations of interest

WJF has received speaker, travel, and advisor honoraria from Grünenthal, Baxter, Merck, and Smiths. He is website editor and executive committee member of the ERAS Society. MGM is an editorial board member of the *British Journal of Anaesthesia*, consultant for Edwards Lifesciences, and consultant for Deltax Medical. MJS has received speaker, travel, and advisor honoraria from Edwards Lifesciences, Baxter, and Merck; is education chair and executive committee member of the ERAS Society; and is president-elect of ERAS USA.

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