전공의 연수교육 PART VI: 중환자
2022년 5월 20일 (금) 15:30-17:00

Early Recovery After Surgery (ERAS) Protocol

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E R A S

: Enhanced Recovery After Surgery

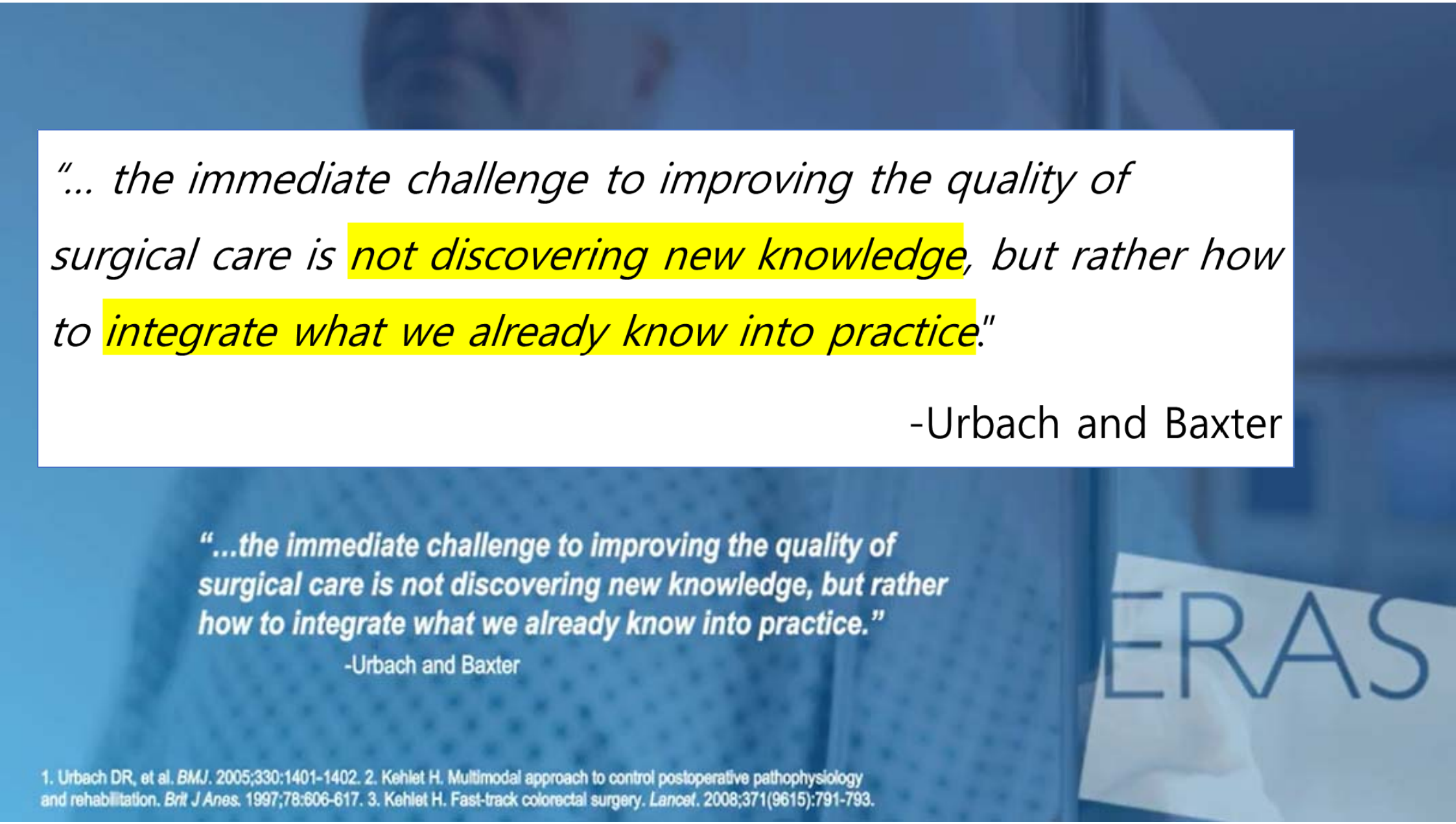
Enhanced Recovery After Surgery (ERAS) Protocol

Current Surgical Challenges

Cohen ME, et al. Ann Surg. 2009;250(6):901-907

"... the immediate challenge to improving the quality of surgical care is not discovering new knowledge, but rather how to integrate what we already know into practice."

-Urbach and Baxter



1. Urbach DR, et al. *BMJ*. 2005;330:1401-1402. 2. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Brit J Anes*. 1997;78:606-617. 3. Kehlet H. Fast-track colorectal surgery. *Lancet*. 2008;371(9615):791-793.

ERAS

Enhanced Recovery After Surgery

Fast-track patients on the road to recovery

- Evidence-based (근거중심)
- Multidisciplinary (다학제적)
- Multi-modal (다중적)
- Continuous audit (지속적인 감시)와 Feedback을 통한 순응도 확인

https://www.patient-education.com/eras.html

Where did ERAS begin?

Prof. Henrik Khelet MD PhD

Colorectal surgeon

Hvidovre Hospital (post 2004 Rigshospitalet København)

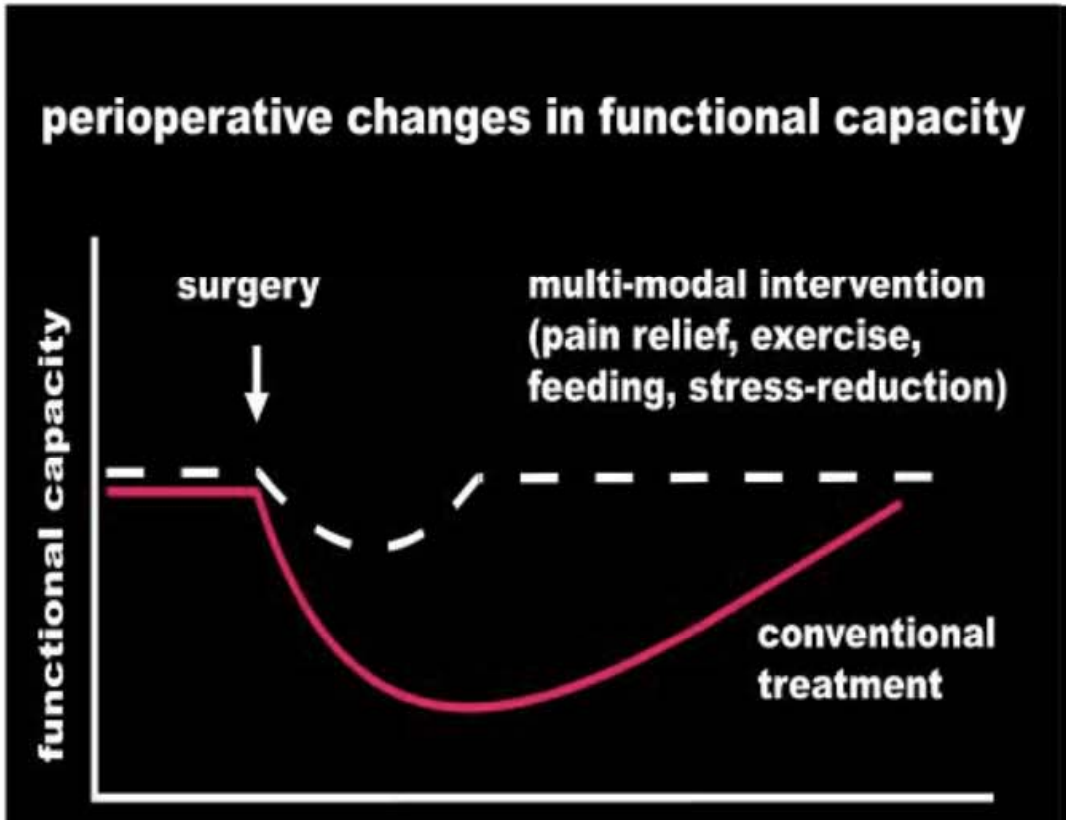
Pre-emptive analgesia - epidurals and nitrogen balance

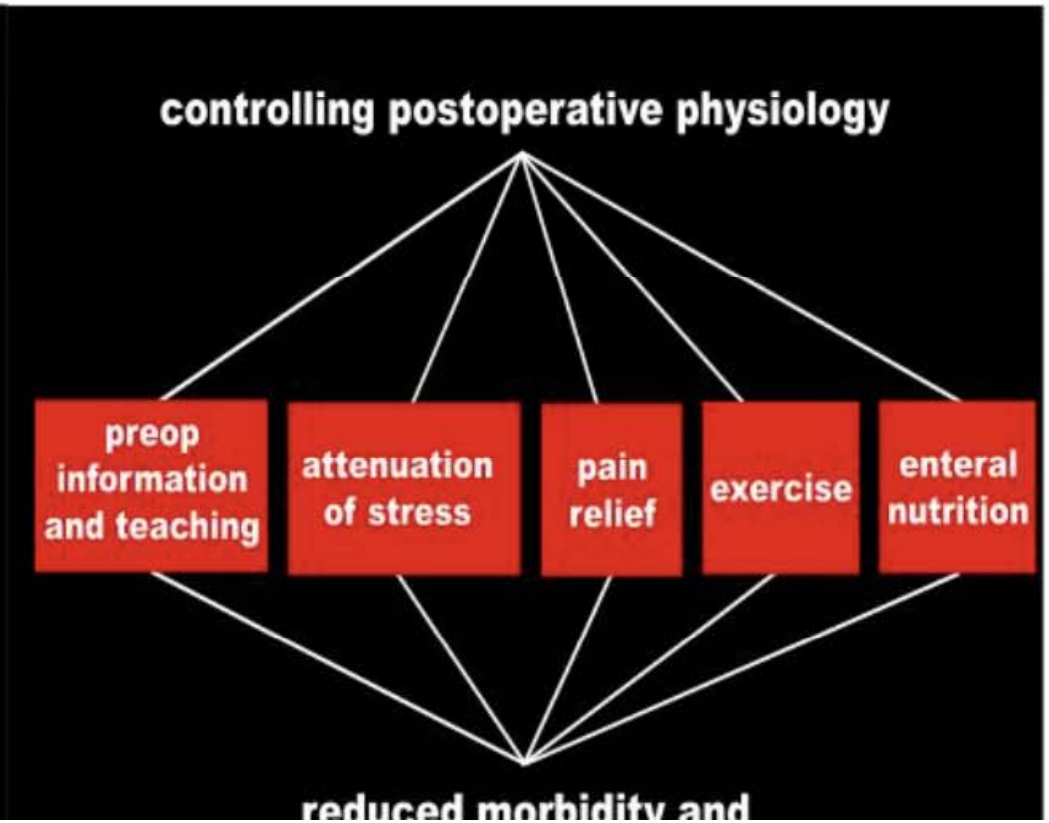
Evolved to “fast track” surgery mid 1990’s

ERAS born 2001

ERAS protocol results in accelerated recovery and shorter hospital stay

Multimodal treatment
ad modum
Henrik Kehlet,
Hvidovre, Danmark



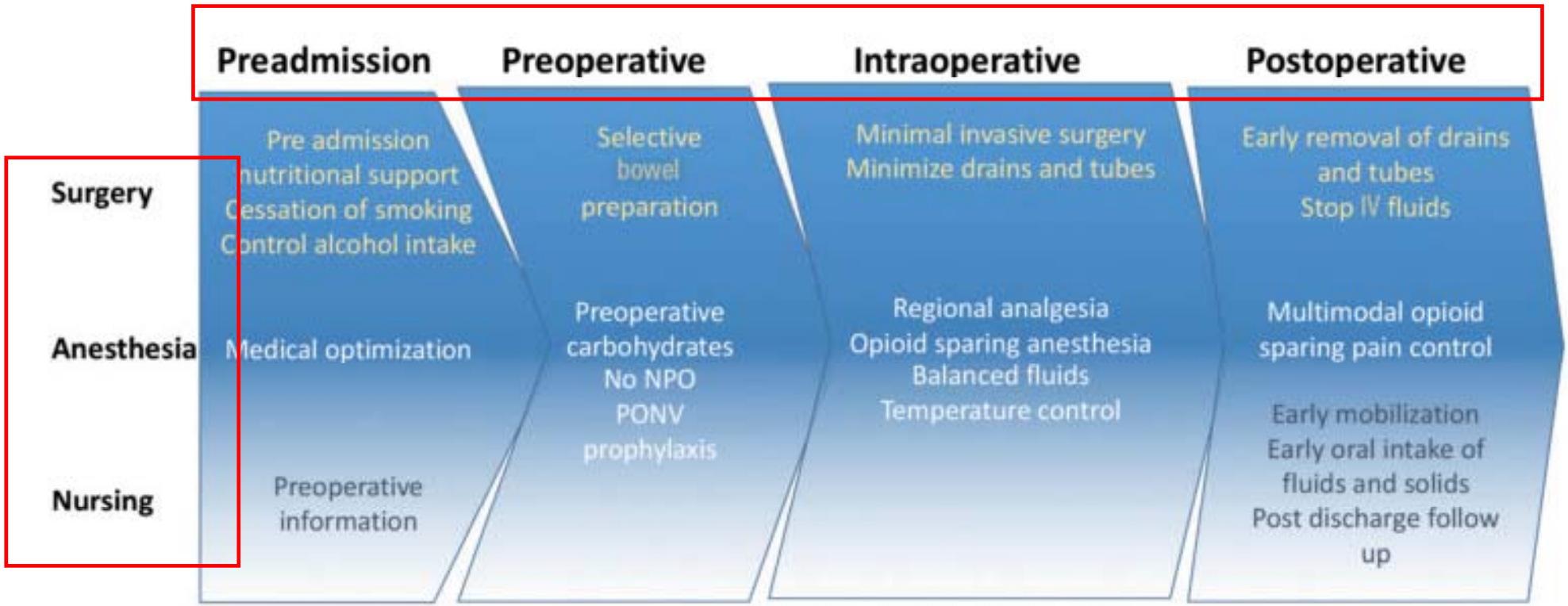


List of ERAS society guideline

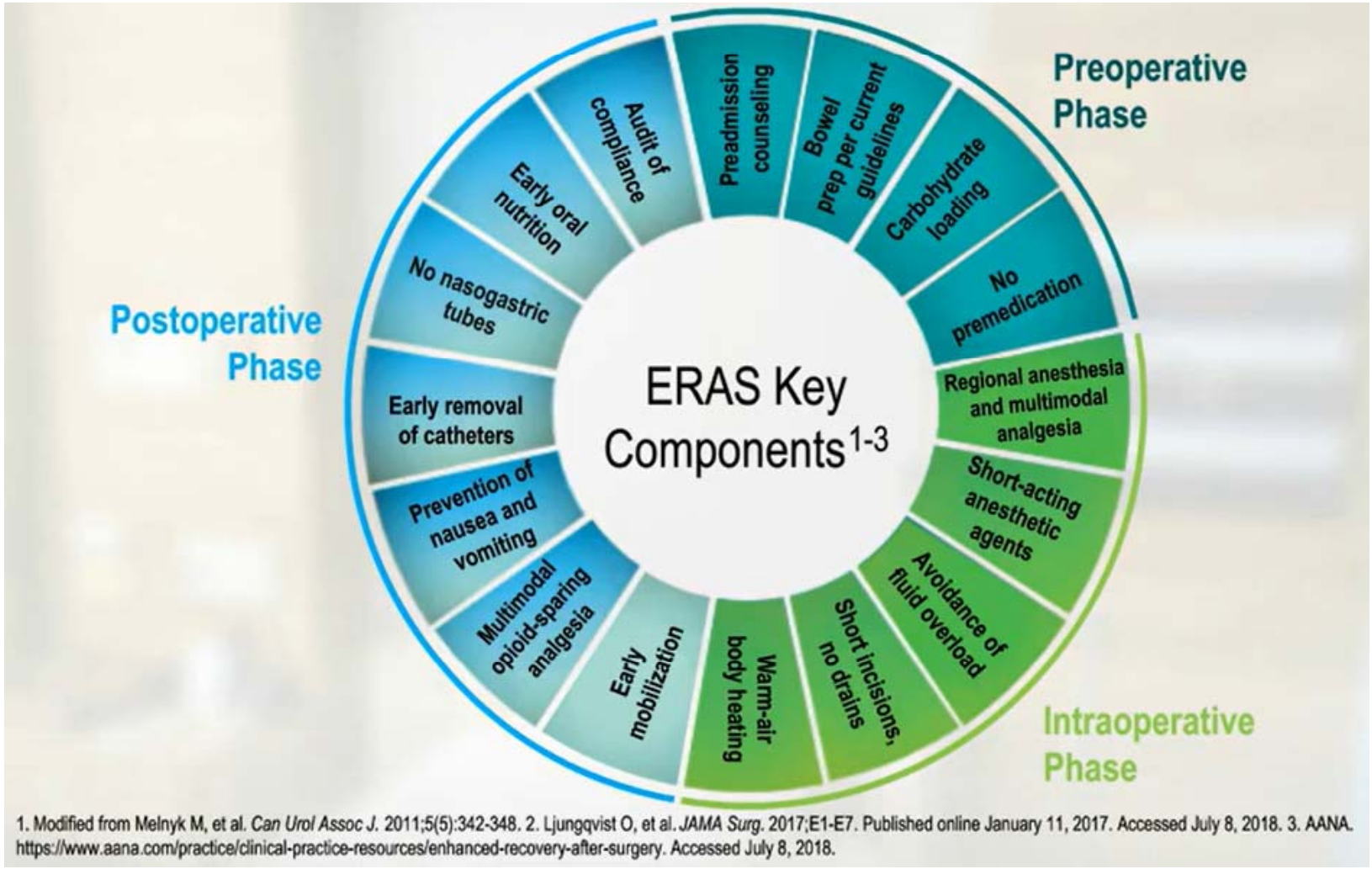
https://erassociety.org/

Year	Surgery
2012	Colonic resection Rectal/pelvic surgery Pancreatoduodenectomy
2013	Radical cystectomy
2014	Gastrectomy
2015	Anesthesia for gastrointestinal surgery Gynecologic/oncologic surgery
2016	Bariatric surgery Liver surgery Head and neck cancer surgery
2017	Breast reconstruction
2018	Colorectal surgery: update Lung surgery Esophagectomy
2019	Gynecologic/oncologic surgery: update Total hip/knee replacement Cardiac surgery Cesarean section Pancreatoduodenectomy: update
2020	Neonatal intestinal surgery Cytoreductive surgery
2021	Lumbar spinal fusion

ERAS® Society Enhanced Recovery flow chart



Source: Olle Ljungqvist, MD, PhD, Örebro University, Örebro, Sweden. Used with permission.



1. Modified from Melnyk M, et al. *Can Urol Assoc J.* 2011;5(5):342-348. 2. Ljungqvist O, et al. *JAMA Surg.* 2017;E1-E7. Published online January 11, 2017. Accessed July 8, 2018. 3. AANA. https://www.aana.com/practice/clinical-practice-resources/enhanced-recovery-after-surgery. Accessed July 8, 2018.

ERAS Key Components (1): **Pre-operative Phase**

- Patient **education** / pre-admission **counselling (smoking, alcohol)**
- **Nutritional** optimization and carbohydrate loading
- Preop-**preparation** as appropriate
- Exercise / **pre-habilitation**

ERAS Key Components (2): Intra-operative Phase

- Short-acting **anesthetic agents**
- Maximize use of **multimodal analgesia**
- Avoidance of fluid overload and **Goal-direct fluid therapy**
- Short **incision** and minimal **drains** catheter
- **Hypothermia** control

ERAS Key Components (3): **Post-operative Phase**

- Early **enteral** nutrition
- Prevention of nausea and vomiting (**PONV**)
- Early removal of **drain/catheters**
- Multi-modal opioids-sparing **analgesia**
- Early **mobilization**
- Audit of **compliance**

ERAS in Thoracic and Cardiovascular Surgery

1. ERAS in Cardiac Surgery
2. ERAS in Thoracic Surgery
3. ERAS in Esophagectomy

- **Level of Evidence**

  : High / Moderate / Low

- **Class of Recommendation**

  : Strong / Moderate / Weak / No benefit / Harmful

- **Level of Evidence**

  : High / Moderate / Low

- **Class of Recommendation**

  : Strong / Moderate / Weak / No benefit / Harmful

Limitations of ERAS

- Comprehensive, but relatively superficial
- Acknowledge Center or Physician specific policy/preference
- Build in Western country

ERAS in Thoracic Surgery

1. Preoperative phase
2. Admission
3. Perioperative phase
4. Postoperative phase

European Journal of Cardio-Thoracic Surgery 55 (2019) 91–115
doi:10.1093/ejcts/ezy301 Advance Access publication 9 October 2018

GUIDELINES

Cite this article as: Batchelor TJP, Rasburn NJ, Abdelnour-Berchtold E, Brunelli A, Cerfolio RJ, Gonzalez M *et al.* Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS). Eur J Cardiothorac Surg 2019;55:91–115.

Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS)

Timothy J.P. Batchelor[a,*], Neil J. Rasburn[b], Etienne Abdelnour-Berchtold[c], Alessandro Brunelli[d], Robert J. Cerfolio[e], Michel Gonzalez[c], Olle Ljungqvist[f], René H. Petersen[g], Wanda M. Popescu[h], Peter D. Slinger[i] and Babu Naidu[j]

1. Preoperative phase

(1) Preadmission information, education and counselling

1. Patients should routinely receive dedicated preoperative counselling

Evidence level (Low) / Recommendation grade (Strong)

(2) Perioperative nutrition

1. Patients should be screened pre-operatively for nutritional status and weight loss

   Evidence level (High) / Recommendation grade (Strong)

2. Oral nutritional supplements should be given to malnourished patients

   Evidence level (Moderate) / Recommendation grade (Strong)

(2) Perioperative nutrition

3. Immune-enhancing nutrition may have a role in the malnourished patient postoperatively

Evidence level (Low) / Recommendation grade (Weak)

(3) Smoking cessation

1. Smoking should be stopped at least 4 weeks before surgery

Evidence level (High) / Recommendation grade (Strong)

(4) Alcohol dependency management

1. Alcohol consumption (in alcohol abusers) should be avoided for at least 4 weeks before surgery

Evidence level (Moderate) / Recommendation grade (Strong)

문제

- 수술 전 흡연과 음주는 수술 후 폐 기능 감소, 출혈 및 감염 등의 합병증을 증가시키는 것으로 알려져 있다. 정규 수술의 경우 일반적으로 얼마 주전부터 금연과 금주를 권장하는가?
    1. 1주
    2. 2주
    3. 3주
    4. 4주
    5. 5주

문제

- 수술 전 흡연과 음주는 수술 후 폐 기능 감소, 출혈 및 감염 등의 합병증을 증가시키는 것으로 알려져 있다. 정규 수술의 경우 일반적으로 얼마 주전부터 금연과 금주를 권장하는가?
  1. 1주
  2. 2주
  3. 3주
  4. 4주
  5. 5주

(5) Anemia management

1. Anemia should be identified, investigated and corrected preoperatively

Evidence level (High), Recommendation grade (Strong)

(6) Pulmonary rehabilitation and pre-habilitation

1. Pre-habilitation should be considered for patients with borderline lung function or exercise capacity

Evidence level (Low), Recommendation grade (Strong)

2. Admission

(1) Preoperative fasting and carbohydrate treatment

1. Clear fluids should be allowed up until 2 h before the induction of anesthesia and solids until 6 h before induction of anesthesia

   Evidence level (High), Recommendation grade (Strong)

2. Oral carbohydrate loading reduces postoperative insulin resistance and should be used routinely

   Evidence level (Low), Recommendation grade (Strong)

(2) Preanesthetic medication

1. Routine administration of sedatives to reduce anxiety preoperatively should be avoided

Evidence level (Moderate) / Recommendation grade (Strong)

3. Perioperative phase

(1) Venous thromboembolism prophylaxis

1. Patients undergoing major lung resection should be treated with pharmacological and mechanical VTE prophylaxis.

   Evidence level (Moderate) / Recommendation grade (Strong)

2. Patients at **high risk of VTE** may be considered for extended prophylaxis with LMWH for up to 4 weeks.

   Evidence level (Low) / Recommendation grade (Weak)

(2) Antibiotic prophylaxis and skin preparation

1. Routine intravenous antibiotics should be administered within 60 min of, but prior to, the skin incision.

   Evidence level (High) / Recommendation grade (Strong)

2. Hair clipping is recommended if hair removal is required.

   Evidence level (High) / Recommendation grade (Strong)

3. Chlorhexidine–alcohol is preferred to povidone-iodine solution for skin preparation.

   Evidence level (High) / Recommendation grade (Strong)

(3) Preventing intraoperative hypothermia

1. Maintenance of normothermia with convective active warming devices should be used perioperatively

   Evidence level (High) / Recommendation grade (Strong)

2. Continuous measurement of core temperature for efficacy and compliance is recommended

   Evidence level (High) / Recommendation grade (Strong)

(4) Standard anesthetic protocol

1. Lung-protective strategies should be used during one-lung ventilation

   Evidence level (Moderate) / Recommendation grade (Strong)

2. A combination of regional and general anesthetic techniques should be used

   Evidence level (Low) / Recommendation grade (Strong)

3. Short-acting volatile or intravenous anesthetics, or their combination, are equivalent choices

   Evidence level (Low) / Recommendation grade (Strong)

(5) PONV (postoperative nausea and vomiting) control

1. Non-pharmacological measures to decrease the baseline risk of PONV should be used in all patients

   Evidence level (High) / Recommendation grade (Strong)

2. A multimodal pharmacological approach for PONV prophylaxis is indicated in patients at moderate risk or high risk

   Evidence level (Moderate), Recommendation grade (Strong)

(6) Regional anesthesia and pain relief

1. Regional anesthesia is recommended with the aim of reducing postoperative opioid use. Paravertebral blockade provides equivalent analgesia to epidural anesthesia

   Evidence level (High) / Recommendation grade (Strong)

2. A combination of acetaminophen and NSAIDs should be administered regularly to all patients unless contraindications exist

   Evidence level (High), Recommendation grade (Strong)

(6) Regional anaesthesia and pain relief

3. Ketamine should be considered for patients with pre-existing chronic pain.

Evidence level (Moderate) / Recommendation grade (Strong)

4. Dexamethasone may be administered to prevent PONV and reduce pain

Evidence level (Low), Recommendation grade (Strong)

(7) Perioperative fluid management

1. Very restrictive or liberal fluid regimes should be avoided in favor of euvolemia.

   Evidence level (Moderate) / Recommendation grade (Strong)

2. Balanced crystalloids are the intravenous fluid of choice and are preferred to 0.9% saline.

   Evidence level (High) / Recommendation grade (Strong)

(7) Perioperative fluid management

3. Intravenous fluids should be discontinued as soon as possible and replaced with oral fluids and diet.

Evidence level (Moderate) / Recommendation grade (Strong)

(8) Atrial fibrillation prevention

1. Patients taking b-blockers preoperatively should continue to take them in the postoperative period.

   Evidence level (High) / Recommendation grade (Strong)

2. Magnesium supplementation may be considered in magnesium deplete patients.

   Evidence level (Low) / Recommendation grade (Weak)

(8) Atrial fibrillation prevention

3. It is reasonable to administer diltiazem preoperatively or amiodarone postoperatively for patients at risk.

Evidence level (Moderate) / Recommendation grade (Weak)

(9) Surgical technique: thoracotomy

1. If a thoracotomy is required, a muscle-sparing technique should be performed

   Evidence level (Moderate) / Recommendation grade (Strong)

2. Intercostal muscle- and nerve-sparing techniques are recommended

   Evidence level (Moderate) / Recommendation grade (Strong)

3. Re-approximation of the ribs during thoracotomy closure should spare the inferior intercostal nerve

   Evidence level (Moderate) / Recommendation grade (Strong)

(10) Surgical technique: minimally invasive surgery

1. A VATS approach for lung resection is recommended for early-stage lung cancer

Evidence level (High), Recommendation grade (Strong)

4. Postoperative phase

(1) Chest drain management

1. The routine application of external suction should be avoided

   Evidence level (Low) / Recommendation grade (Strong)

2. Digital drainage systems reduce variability in decision-making and should be used

   Evidence level (Low) / Recommendation grade (Strong)

(1) Chest drain management

3. Chest tubes should be removed even if the daily serous effusion is of high volume (up to 450 ml/24 h)

Evidence level (Moderate) / Recommendation grade (Strong)

4. A single tube should be used instead of 2 after anatomical lung resection

Evidence level (Moderate) / Recommendation grade (Strong)

(2) Urinary drainage

1. In patients with normal preoperative renal function, a transurethral catheter should not be routinely placed for the sole purpose of monitoring urine output

   Evidence level (Moderate) / Recommendation grade (Strong)

2. It is reasonable to place a transurethral catheter in patients with thoracic epidural anesthesia

   Evidence level (Low) / Recommendation grade (Strong)

(3) Early mobilization and adjuncts to physiotherapy

1. Patients should be mobilized within 24 h of surgery

   Evidence level (Low) / Recommendation grade (Strong)

2. Prophylactic mini-tracheostomy use may be considered in certain high-risk patients

   Evidence level (Low) / Recommendation grade (Weak)

ERAS in Esophagectomy

1. Procedure-specific components
2. Operative components
3. Non-procedure-specific components

World J Surg (2019) 43:299–330
https://doi.org/10.1007/s00268-018-4786-4

World Journal of Surgery

SCIENTIFIC REVIEW

Guidelines for Perioperative Care in Esophagectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

Donald E. Low[1] · William Allum[2] · Giovanni De Manzoni[3] · Lorenzo Ferri[4] · Arul Immanuel[5] · MadhanKumar Kuppusamy[1] · Simon Law[6] · Mats Lindblad[7] · Nick Maynard[8] · Joseph Neal[1] · C. S. Pramesh[9] · Mike Scott[10] · B. Mark Smithers[11] · Valérie Addor[12] · Olle Ljungqvist[13]

1. Procedure-specific components

(1) Preoperative nutritional assessment and treatment

1. Nutritional assessment should be undertaken in all patients with a view to detecting and optimizing nutritional status before surgery.

Level of evidence: Low

Recommendation grade: Strong

(2) Preoperative nutritional intervention

1. In high-risk cases enteral support is indicated preferably using the GI tract with selective use of feeding tubes.

Level of evidence: Low

Recommendation grade: Strong

(3) Preoperative oral pharmaco-nutrition

1. Evidence in support of pharmaco-nutrition for patients undergoing surgery for esophageal cancer is conflicting and its routine use cannot be supported at this time.

Level of evidence: Moderate

Recommendation grade: Strong

(4) Multidisciplinary tumor board

1. There is limited data to support an improvement in overall survival.
2. MDTs should be fundamental to management planning for all patients with esophageal cancer.
3. MDTs ensure appropriate multidisciplinary input into patient care and improve the quality of that care.

Level of evidence: Moderate

Recommendation grade: Strong

(5) Pre-habilitation programs

1. Evidence from small studies supports the use of prehabilitation programs for major abdominal surgery, however there is limited data for esophagectomy.
2. Patients undergoing esophagectomy may benefit from a multimodal prehabilitation program and ongoing assessments may provide additional information to direct future recommendations.

Level of evidence(*Extrapolated, Small Studies*): Low

Recommendation grade: Moderate

2. Non-procedure-specific components

(1) Preoperative counseling patient/family

1. Patients undergoing esophagectomy, and their family or care-giver, should receive pre-operative counseling with emphasis on perioperative and postoperative targets and goals.

Level of evidence: Low

Recommendation grade: Strong

(2) Smoking–alcohol cessation

1. Smoking should be stopped 4 weeks prior to surgery and regular high alcohol consumers should abstain at least 4 weeks before surgery to reduce postoperative complications.

Level of evidence(*Extrapolated*): Moderate

Recommendation grade: Strong

(3) Cardiopulmonary assessment

1. CPET results have been used to assess patients undergoing major surgery, to guide preoperative optimization, to predict postoperative cardiopulmonary complications after surgery and, in some centers, to assess whether borderline patients should undergo resection.
2. Evidence in support of the use of exercise derived parameters in risk stratification of esophageal resection patients is currently limited.

Level of evidence: Low

Recommendation grade: Moderate

(4) Bowel preparation (regarding colonic reconstruction)

1. Mechanical bowel preparation does not reduce the incidence of postoperative complications and should not be used routinely prior to esophageal resection with gastric reconstruction.
2. Most surgeons would still recommend MBP for planned colonic reconstruction although evidence is lacking.

Level of evidence(*Extrapolated*): Moderate

Recommendation grade: Strong

(5) Preoperative fasting

1. Prolonged fasting should be avoided, and clear liquids, including specific preoperative high-carbohydrate drinks, should be allowed until 2 h prior to esophagectomy.
2. Caution should be applied for patients with significant dysphagia or other obstructive symptoms.

Avoidance of preoperative fasting.

Level of evidence: High / Recommendation grade: Strong

Preoperative carbohydrate drinks (Extrapolated)

Level of evidence: Low / Recommendation grade: Moderate

(6) Pre-anesthetic analgesics and anxiolytics

1. Long-acting anxiolytics should be avoided, especially in the elderly, while short acting drugs may be used to reduce preoperative anxiety.
2. Level of evidence: Moderate
3. Recommendation grade: Weak

(7) Postoperative nausea and vomiting

1. Prophylaxis in high-risk patients can reduce the incidence of PONV.
2. The use of a combination therapy is recommended.
3. If PONV occurs, therapy with 5-hydroxytryptamine (HT) receptor antagonists/Serotonin receptor antagonis should be preferred.

Level of evidence(*Extrapolated*): Low

Recommendation grade: Strong

(8) Beta-blockade (1)

1. Prophylactic beta-blockage for non-cardiac surgery reduces the incidence of postoperative myocardial infarction and supraventricular arrhythmias, but may potentially increase stroke, hypotension, bradycardia and even death.
2. The beneficial effects seem to be cardiac-risk related and are only seen in those with moderate to high cardiac risk.

Level of evidence: Moderate

Recommendation grade: Strong

(8) Beta-blockade (2)

3. Current evidence supports continuing beta-blockers in the perioperative period in those who are chronically on beta-blockers and to prescribe beta-blockers for high-risk patients with coronary artery disease undergoing high- risk non-cardiac operations.

Level of evidence: Moderate

Recommendation grade: Strong

(9) Prophylaxis of atrial dysrhythmia

1. Prophylactic amiodarone may reduce the incidence of postoperative atrial fibrillation, but current evidence does not support reduction in length of stay, overall morbidity or mortality in patients undergoing esophagectomy.
2. Perioperative cardiac rhythm management strategies should be patient specific, aimed to reduce the modifiable risk factors and prompt recognition and treatment of associated or contributory complications.

Level of evidence: Moderate

Recommendation grade: Moderate

(10) Antithrombotic prophylaxis (1)

1. Antithrombotic prophylaxis with LMWH, together with mechanical measures, reduce the risk of VTE.
2. Treatment should be started 2–12 h before the operation and should continue for 4 weeks after the operation.

Level of evidence: High

Recommendation grade: Strong

(10) Antithrombotic prophylaxis (2)

3. An epidural catheters should be placed no sooner than 12 h from the last LMWH does.
4. LMWH should not be given until at least 4 h have passed after epidural catheter removal.

Level of evidence: High

Recommendation grade: Strong

(11) Hypothermia

1. Intraoperative hypothermia leads to adverse postoperative events.
2. Measures to maintain normothermia, such as forced-air blankets, warming mattress or circulating- water garment systems, use of warm intravenous fluid should be recommended.
3. Temperature monitoring with an aim of maintaining core temperature of above 36 ℃ (or 96.8 F) is desirable.

Level of evidence: High

Recommendation grade: Strong

(12) Postoperative glycemic control (1)

1. Reducing insulin resistance and treatment of excessive hyperglycemia is strongly associated with improved outcomes.
2. A multi-modal approach to minimize the metabolic stress of surgery is recommended to reduce insulin resistance and hyperglycemia.

Level of evidence: Moderate

Recommendation grade: Strong

(12) Postoperative glycemic control (2)

3. Preoperative carbohydrate treatment, epidural anesthesia, minimally invasive surgical techniques and early enteral feeding are recommended.
4. Blood glucose levels above 10 mmol/L (180 mg/dl) should be treated.

Level of evidence: Moderate

Recommendation grade: Strong

(13) Bowel stimulation

1. A multimodal approach with epidural analgesia and near- zero fluid balance is recommended.
2. Oral laxatives and chewing gum given postoperatively are safe and may accelerate gastrointestinal transit.

Level of evidence: Low

Recommendation grade: Weak

(14) Foley catheter management (1)

1. Expeditious removal of urinary catheters following surgery can positively impact rates of postoperative urinary tract infections.
2. However, in patients that have had a thoracotomy and who have an epidural catheter in place, removal of the urinary catheter prior to removal of the epidural catheter carries a significant risk for urinary catheter replacement notably in males.

Level of evidence: High

Recommendation grade: Strong

(14) Foley catheter management (2)

3. Catheter removal within 48 h has higher incidence of reinsertion for urinary retention.
4. Early removal of urinary catheters is worthy of consideration but there needs to be strict protocols for patient bladder monitoring to assess the need for catheter reinsertion.

Level of evidence: High

Recommendation grade: Strong

(14) Foley catheter management (3)

5. Urinary infection rates are lower with the use of a suprapubic catheter if urinary drainage required for longer than 4 days.

Level of evidence: High

Recommendation grade: Moderate

ERAS in Cardiac Surgery

1. Before surgery
2. During surgery
3. After surgery

Clinical Review & Education

JAMA Surgery | Special Communication

Guidelines for Perioperative Care in Cardiac Surgery
Enhanced Recovery After Surgery Society Recommendations

Daniel T. Engelman, MD; Walid Ben Ali, MD; Judson B. Williams, MD, MHS; Louis P. Perrault, MD, PhD; V. Seenu Reddy, MD; Rakesh C. Arora, MD, PhD; Eric E. Roselli, MD; Ali Khoynezhad, MD, PhD; Marc Gerdisch, MD; Jerrold H. Levy, MD; Kevin Lobdell, MD; Nick Fletcher, MD, MBBS; Matthias Kirsch, MD; Gregg Nelson, MD; Richard M. Engelman, MD; Alexander J. Gregory, MD; Edward M. Boyle, MD

Enhanced Recovery After Surgery (ERAS) evidence-based protocols for perioperative care can lead to improvements in clinical outcomes and cost savings. This article aims to present consensus recommendations for the optimal perioperative management of patients undergoing cardiac surgery. A review of meta-analyses, randomized clinical trials, large nonrandomized studies, and reviews was conducted for each protocol element. The quality of the evidence was graded and used to form consensus recommendations for each topic. Development of these recommendations was endorsed by the Enhanced Recovery After Surgery Society.

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Invited Commentary page 767

Supplemental content

CME Quiz at jamanetwork.com/learning and CME Questions page 788

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1. Before surgery

(1) Alcohol & Smoking Cessation

1. Smoking and hazardous alcohol consumption should be stopped 4 weeks before elective surgery.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level C-LD (Limited Data)

(2) A1C and Correction of Nutritional Deficiency

1. Preoperative measurement of hemoglobin A1c is recommended to assist with risk stratification.

Class (Strength) of Recommendation: Class IIa(Moderate)

Level (Quality) of Evidence: Level C-LD (Limited Data)

2. Preoperative correction of nutritional deficiency is recommended when feasible.

Class (Strength) of Recommendation: Class IIa(Moderate)

Level (Quality) of Evidence: Level C-LD (Limited Data)

(3) Avoidance of Prolonged Fasting

1. Clear liquids may be continued up until 2-4 hours before general anesthesia.

Class (Strength) of Recommendation: Class IIb (Weak)

Level (Quality) of Evidence: Level C-LD (Limited Data)

2. Preoperative carbohydrate loading may be considered before surgery.

Class (Strength) of Recommendation: Class IIb (Weak)

Level (Quality) of Evidence: Level C-LD (Limited Data)

(4) Patient Engagement Technology

1. Patient engagement tools, including online/application-based systems to promote education, compliance, and patient-reported outcomes are recommended.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level C-LD (Limited Data)

(5) Prehabilitation

1. Pre-habilitation is recommended for patients undergoing elective surgery with multiple comorbidities or significant deconditioning.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level B-NR (Non-randomized)

2. During surgery

(1) Antifibrinolytics

1. Tranexamic acid or epsilon aminocaproic acid is recommended during on-pump cardiac surgical procedures.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level A

문제

- 심폐기를 이용한 심장 수술을 시행하는 동안 적절한 항섬유소 용해제 사용은 수술 후 출혈과 수혈량을 감소시킨다. 다음 중 가장 흔하게 사용하지만 고용량 사용 시 발작을 일으키는 것으로 알려져 있는 항섬유소 용해제는?
    1. Aprotinin
    2. Desmopressin
    3. Epsilon aminocaproic acid
    4. Tranexamic acid
    5. 4-aminomethylbenzoic acid

문제

- 심폐기를 이용한 심장 수술을 시행하는 동안 적절한 항섬유소 용해제 사용은 수술 후 출혈과 수혈량을 감소시킨다. 다음 중 가장 흔하게 사용하지만 고용량 사용 시 발작을 일으키는 것으로 알려져 있는 항섬유소 용해제는?

  1. Aprotinin
  2. Desmopressin
  3. Epsilon aminocaproic acid
  4. Tranexamic acid
  5. 4-aminomethylbenzoic acid

(2) Avoidance of Hyperthermia

1. Hyperthermia (>37.9 C) while rewarming on cardiopulmonary bypass is potentially harmful and should be avoided.

Class (Strength) of Recommendation: Class III: Harm (Strong)

Level (Quality) of Evidence: Level B-R (Randomized)

(3) Infection Reduction Bundle

1. A care bundle of evidenced based best practices is recommended to reduce surgical site infections.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-R (Randomized)

(4) Optimization of Sternal Closure

1. Rigid sternal fixation can be useful to improve/accelerate sternal healing and reduce mediastinal wound complications.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level B-R (Randomized)

3. After surgery

(1) Avoidance of Hypothermia

1. Persistent hypothermia after CPB should be avoided in the early postoperative period.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-NR (Non-randomized)

(2) Biomarkers for Acute Kidney Injury

1. Early detection of kidney stress and interventions to avoid acute kidney injury are recommended following surgery.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level B-R (Randomized)

(3) Chest Drain Management

1. Stripping or breaking the sterile field of chest tubes to remove clot is not recommended.

Class (Strength) of Recommendation: Class III: No Benefit (Moderate)

Level (Quality) of Evidence: Level A

2. Maintenance of chest tube patency is recommended to prevent retained blood.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-R (Randomized)

(4) Delirium Screening

1. Postoperative systematic delirium screening is recommended at least once per nursing shift.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-NR (Non-randomized)

(5) Early Extubation

1. Strategies to ensure extubation within 6 hours of surgery are recommended.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level B-NR (Non-randomized)

(6) Glycemic Control

1. Perioperative glycemic control is recommended.

Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-R (Randomized)

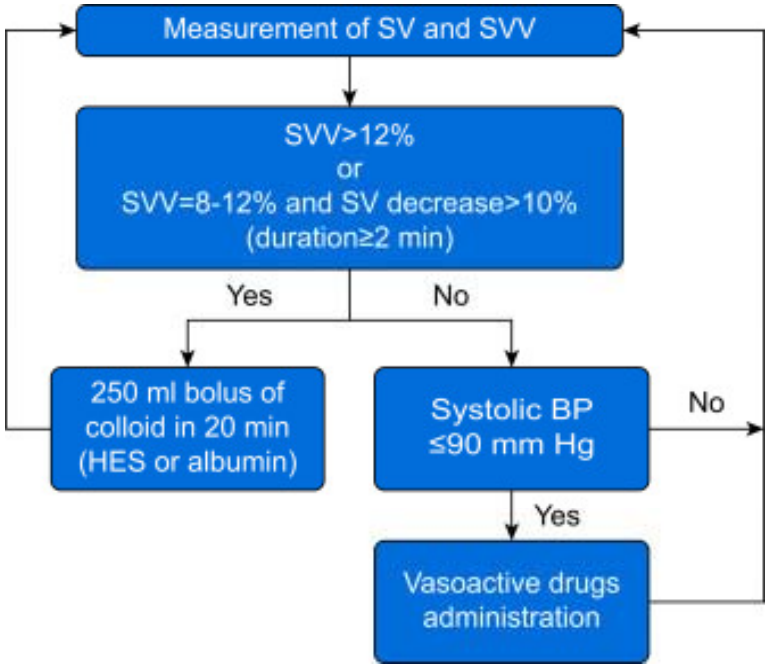
2. An insulin infusion is recommended to treat hyperglycemia in all patients postoperatively.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level B-NR (Non-randomized)

(7) Goal-Directed Therapy

1. Goal directed fluid therapy is recommended to reduce postoperative complications.

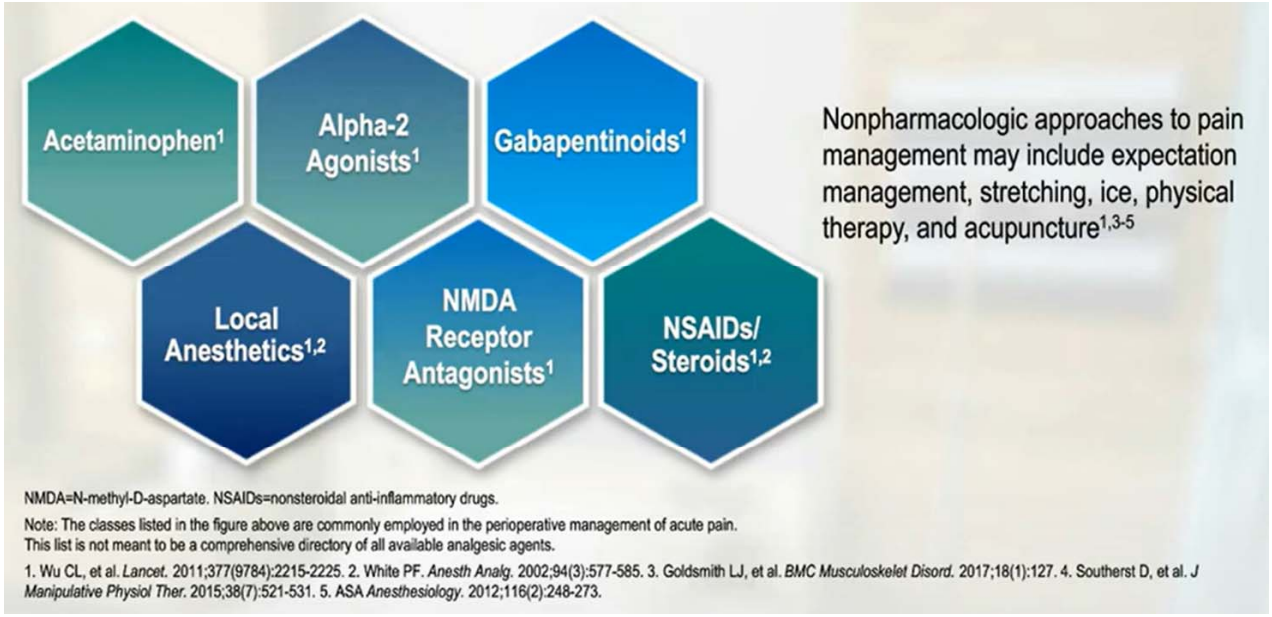


Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-R (Randomized)

(8) Multimodal Analgesia

1. A multimodal, opioid-sparing, pain management plan is recommended postoperatively.



Class (Strength) of Recommendation: Class I (Strong)

Level (Quality) of Evidence: Level B-NR (Non-randomized)

(9) Thromboprophylaxis

1. Chemical thrombo-prophylaxis is recommended following surgery.

Class (Strength) of Recommendation: Class IIa (Moderate)

Level (Quality) of Evidence: Level C-LD (Limited Data)

Conclusion

- ERAS는 근거중심의 표준화된 가이드라인에 따라 수술 환자들을 통합적으로 관리하여 수술 후 회복의 질을 향상시키는 프로그램이다.
- ERAS는 각 단계, 세부 항목에 대한 근거중심 연구결과가 활발하게 만들어지고 있으며, 이미 수많은 연구에서 ERAS의 역할이 증명이 있다.
- ERAS는 흉부외과 영역에서도 의미 있는 임상 결과 개선 및 의료비용 절감과 관련이 있다는 긍정적인 보고가 많아지고 있다.

- 하지만 ERAS와 관련된 내용이 워낙 방대하고, 아직까지 근거가 충분하지 않은 항목들이 상당히 많다는 한계가 있다.
- 또한 여러 가지 이유로 ERAS를 적용하지 않는 병원이 많은데, 그 중 가장 중요한 것은 의료진이 진료 관행을 바꾸는 데 어려움을 느끼기 때문이다.
- 이를 극복하기 위해 ERAS 개발은 아직 현재 진행형이며, 다학제적 접근을 통한 높은 수준의 근거 마련과 의료진의 인식 개선 등이 필요하다.

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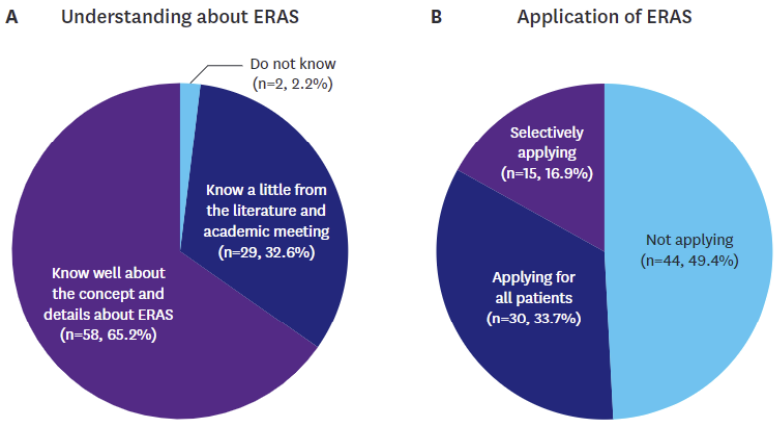

Fig. 1. Level of understanding about ERAS (A) and application of ERAS (B).
ERAS = enhanced recovery after surgery.

Thank you for your attention

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