Review

Consensus guidelines for enhanced recovery after gastrectomy

Enhanced Recovery After Surgery (ERAS®) Society recommendations

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Background: **Application of evidence-based perioperative care protocols reduces complication rates, accelerates recovery and shortens hospital stay. Presently, there are no comprehensive guidelines for perioperative care for gastrectomy.**

Methods: **An international working group within the Enhanced Recovery After Surgery (ERAS®) Society assembled an evidence-based comprehensive framework for optimal perioperative care for patients undergoing gastrectomy. Data were retrieved from standard databases and personal archives. Evidence and recommendations were classified according to the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system and were discussed until consensus was reached within the group. The quality of evidence was rated 'high', 'moderate', 'low' or 'very low'. Recommendations were graded as 'strong' or 'weak'.**

Results: **The available evidence has been summarized and recommendations are given for 25 items, eight of which contain procedure-specific evidence. The quality of evidence varies substantially and further research is needed for many issues to improve the strength of evidence and grade of recommendations.**

Conclusion: **The present evidence-based framework provides comprehensive advice on optimal perioperative care for the patient undergoing gastrectomy and facilitates multi-institutional prospective cohort registries and adequately powered randomized trials for further research.**

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Introduction

Enhanced recovery protocols for perioperative care have proven valuable in reducing complications after surgery, improving overall outcomes and shortening length of stay, thus also saving resources[1]. Updated and evidence-based guidelines have been developed by the Enhanced Recovery After Surgery (ERAS®) study group and are now available for colonic and rectal resections and pancreaticoduodenectomies[2–7]. Although several publications have highlighted sporadic efforts to evaluate enhanced recovery or fast-track pathways for patients undergoing elective gastrectomy for cancer[8,9], a comprehensive and evidence-based framework is lacking. A large body of literature suggests that such protocols are pivotal in improving patient outcomes. An international working group with extensive experience in enhanced recovery following surgery aimed to construct a comprehensive and evidence-based framework for best perioperative care in elective gastric cancer surgery and to process this through an expanded international group to achieve consensus behind the recommendations.

Methods

The group was initiated from within the ERAS® Society and was reinforced with acknowledged specialists from

several countries to achieve a broad knowledge base and ensure international validity for the conclusions. A core group (K.M., K.L., M.N., K.S., M.S.) performed a comprehensive literature search between September 2012 and April 2013, and constructed a primary set of recommendations based on reports published between 1985 and 2013. The entire authorship group repeatedly added scientific content, and adjusted evaluation of evidence and strength of conclusions. As most of the authors had worked together on previous guidelines[3,10] and meet repeatedly in person, communication for these guidelines consisted solely of e-mail contact. Lastly, the collaborators offered important input on the guidelines.

All authors screened web-based databases and personal archives for relevant papers. Emphasis was placed on recent publications and papers of good quality (moderate- and high-quality randomized clinical trials (RCTs) and large, high-quality cohort studies as well as systematic reviews and meta-analyses of these). Retrospective series were included if data of better quality were lacking.

The author group specifically included only literature on elective gastric cancer surgery. This was because of the large differences in the extent of dissection necessary in oncological surgery compared with surgery for benign disease such as bariatric surgery, the consequences of which are very different postoperative courses for these patients, and so varying needs for perioperative treatment guidelines. Emergency surgery of any kind was not included.

Quality assessment and grading

The level of evidence and final recommendations were evaluated and adjusted until consensus was achieved. Level of evidence and recommendations were set according to the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system[11–13]. Level of evidence was based on trial design and risk of bias, but also negatively affected if there was inconsistency of results or indirectness of evidence, such as extrapolation from other areas of surgery[11–13]. As for recommendations, the GRADE guidelines state: 'Strong recommendations indicate that the panel is confident that the desirable effects of adherence to a recommendation outweigh the undesirable effects. Weak recommendations indicate that the desirable effects of adherence to a recommendation probably outweigh the undesirable effects, but the panel is less confident'. Recommendations were based not only on the quality of evidence (high, moderate, low, very low) but also on the balance between wanted and unwanted effects, and on values and preferences[13]. The latter implies that, in some instances, strong recommendations may be reached from low-quality data and *vice versa*.

Procedure-specific items *versus* general upper abdominal surgery items

Several enhanced recovery items are probably unrelated to the specific intra-abdominal procedure (for example glycaemic control, fluid management, antimicrobial prophylaxis) and these are referred to here as 'general' as opposed to 'procedure-specific' items. Recent publications have assessed a large number of general enhanced recovery care items, and reached a consensus on perioperative care recommendations for patients undergoing pancreaticoduodenectomy[3,6]. In the absence of procedure-specific evidence, the author group has considered some of these updated recommendations to be valid also for patients undergoing elective gastrectomy. These items are presented in part 2 of the results.

RESULTS PART 1: PROCEDURE-SPECIFIC ITEMS

A summary of the procedure-specific guidelines is shown in *Table 1*.

Preoperative nutrition

A uniform definition of malnutrition that identifies those who will benefit from preoperative nutrition is suggested in the 2009 European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines[14]. Malnutrition is associated with increased morbidity after surgery[15–17]. It appears prudent to identify these patients[18] and give enteral sip feeds, or nasogastric or nasojejunal tube feeding, although data to support intervention are weak. If the tumour precludes access to the duodenum, parenteral nutrition may be warranted[19]. For patients not suffering from significant malnutrition, preoperative artificial nutrition has not been shown to confer benefits[14].

Summary and recommendation

Routine use of preoperative artificial nutrition is not warranted, but significantly malnourished patients should be optimized with oral supplements or enteral nutrition before surgery.

Evidence level: Very low

Recommendation grade: Strong

Preoperative oral pharmaconutrition

Pharmaconutrition (PN) or immunonutrition, denoting the administration of immune-stimulating nutrients (generally arginine, glutamine, ω-3 fatty acids and/or nucleotides), has been evaluated extensively in major surgery and more than 20 RCTs have included patients undergoing upper gastrointestinal surgery[20]. Conclusions are difficult as PN is administered to different patient

Table 1 Procedure-specific guidelines for perioperative care for gastrectomy: Enhanced Recovery After Surgery (ERAS®) Society recommendations

	Summary and recommendations	Evidence level	Recommendation grade
Preoperative nutrition	Routine use of preoperative artificial nutrition is not warranted, but significantly malnourished patients should be optimized with oral supplements or enteral nutrition before surgery	Very low	Strong
Preoperative oral pharmaconutrition	The benefit shown for major gastrointestinal cancer surgery in general has not been reproduced in dedicated trials on patients undergoing gastrectomy. Although a benefit cannot be excluded, there is presently insufficient evidence for this patient group	Moderate	Weak
Access	*Distal gastrectomy:* Evidence supports LADG in early gastric cancer as it results in fewer complications, faster recovery and may be performed to a standard that is oncologically equivalent to open access surgery.	High	Strong
	For advanced disease, T2–T4a gastric cancer, more data on long-term survival comparing LADG and ODG are needed	Moderate	Weak
	Total gastrectomy: There is some evidence supporting LATG owing to lower postoperative complications, shorter hospital stay and oncological safety. However, LATG is technically demanding	Moderate	Weak
Wound catheters and TAP block	Evidence is conflicting regarding wound catheters in abdominal surgery	Wound catheters: Low to moderate	Weak
	Evidence is strong in support of TAP block in abdominal surgery in general, although the effect is evident only during the first 48 h after surgery and none of the evidence is from gastrectomies	TAP blocks: Low	Weak
Nasogastric/nasojejunal decompression	Nasogastric tubes should not be used routinely in the setting of enhanced recovery protocols in gastric surgery	High	Strong
Perianastomotic drains	Avoiding the use of abdominal drains may reduce drain-related complications and shorten hospital stay after gastrectomy	High	Strong
Early postoperative diet and artificial nutrition	Patients undergoing total gastrectomy should be offered drink and food at will from POD 1. They should be advised to begin cautiously and increase intake according to tolerance	Moderate	Weak
	Patients clearly malnourished or those unable to meet 60% of daily requirements by POD 6 should be given individualized nutritional support	Moderate	Strong
Audit	Systematic audit improves compliance and clinical outcomes	Low	Strong

LADG, laparoscopically assisted distal gastrectomy; ODG, open distal gastrectomy; LATG, laparoscopically assisted total gastrectomy; TAP, transversus abdominis plane; POD, postoperative day.

groups, at different time periods relating to surgery, in different combinations and dosages, and compared with control preparations that are not always isonitrogenous. Many trials are more than 10 years old, few are blinded and few investigated only a single component. For major abdominal cancer surgery as a group, there appears to be a benefit from perioperative enteral PN with respect to the rate of infectious complications in malnourished patients, but results are inconsistent[20–26]. In a recent double-blind RCT[27], preoperative PN did not show any benefit in patients, of whom two of three underwent major upper gastrointestinal or hepatopancreatobiliary (HPB) cancer surgery, and all were at nutritional risk. A reduction in mortality has never been demonstrated. A meta-analysis[20] in 2011 identified only one double-blinded trial with adequate blinding assessing PN for gastric cancer surgery. In this trial[28], postoperative PN reduced the rate of surgical wound healing complications. Two recent reviews[19,29] have come to conflicting conclusions regarding PN after oesophageal resections, and no benefit was found in a double-blinded RCT[30] in predominantly oesophagogastric surgery. In two recent large RCTs[31,32], PN, given for 5–7 days after operation to patients undergoing gastrectomy or oesophagogastrectomy, did not confer any benefit. Further trials are warranted and, as this is an issue that lends itself well to double-blinded RCTs, this should be the study design. Future trials should be conducted in modern perioperative care settings and with single immune-enhancing substances.

Summary and recommendation

The possible benefit of reduced infectious and wound healing complications after major gastrointestinal cancer surgery in general has not been reproduced in dedicated, high-quality trials on patients undergoing gastrectomy. Although a benefit cannot be excluded, there is presently insufficient evidence to support routine administration in this patient group and its used is not recommended

Evidence level: Moderate
Recommendation grade: Weak

Access: distal gastrectomy

Distal gastrectomy is defined here as resection of the lower two-thirds of the stomach with lymph node harvest (D1, D1+ and D2) performed according to recommendations from the latest Japanese Gastric Cancer Association treatment guidelines[33]. Early gastric cancer is defined as T1 and any N category, and advanced gastric cancer as T2–4 and any N category.

Six meta-analyses[34–39] (of 6 RCTs, 8 prospective studies and 32 retrospective series) compared laparoscopically assisted distal gastrectomy (LADG) with open distal gastrectomy (ODG). Combining these meta-analyses, a total of 4574 patients with largely early gastric cancer treated with LADG and 4260 with ODG were compared. Although three analyses[35–37] reported longer operating times (mean 71 min), all reported that laparoscopic access resulted in significantly less blood loss. Three analyses[34,35,38] reported shorter time to oral intake (a mean gain of 1 day) and shorter hospital stay (mean 4·5 days less). Overall postoperative morbidity (in particular pulmonary complications) was also reduced after LADG. Two analyses[36,39] reported less postoperative analgesic consumption. There were no differences in anastomotic complications between LADG and ODG. The number of harvested lymph nodes during LADG has been of concern in many publications. Three meta-analyses[35–37] reported a mean of 4·2 fewer lymph nodes harvested, whereas the other three[34,38,39] reported no difference between LADG and ODG. Three RCTs[40–42] including early and advanced gastric cancer reported data on long-term survival (24–62 months), which was found to be similar.

Summary and recommendation

Evidence supports LADG in early gastric cancer as it is associated with fewer complications, faster recovery and may be performed to a standard that is oncologically equivalent to open access surgery. For advanced disease, T2–T4 gastric cancer, more data on long-term survival comparing LADG and ODG are needed.

Evidence level: Early gastric cancer – High
Advanced gastric cancer – Moderate
Recommendation grade: Early gastric cancer – Strong
Advanced gastric cancer – Weak

Access: total gastrectomy

Three meta-analyses[43–45] compared results of laparoscopically assisted total gastrectomy (LATG) in 1497 patients with those of open total gastrectomy (OTG) in 1486 patients treated for both early and advanced gastric cancer. All studies reported longer operating times (mean 54 min) for LATG and all three analyses reported that patients treated by a laparoscopic approach had lower blood loss (mean 120 ml less) and shorter hospital stay (mean stay almost 5 days shorter). One analysis[45] reported less postoperative pain, two[43,45] reported earlier passage of flatus by a mean of 1·2 days, one[45] documented fewer postoperative complications (wound infections and ileus) and one[43] found no differences. No meta-analysis reported any difference in number of retrieved lymph nodes between LATG and OTG, and two meta-analyses[44,45] found an equal 60-month recurrence-free survival. Concerns were

raised about higher anastomotic leak rates after LATG in another publication[46]. Although the results after laparoscopic distal and total gastrectomies are promising, it must be borne in mind that the evidence level is only moderate owing to the shortage of RCTs, and the heterogeneity of data in the prospective and retrospective series on which these trends are based.

Summary and recommendation

Most publications suggest that LATG results in a lower rate of postoperative complications and shorter hospital stay. Data are inconclusive regarding oncological safety for advanced gastric cancer. LATG may be recommended for early gastric cancer wherever surgeons are proficient in the technique and the procedure is established.

Evidence level: Moderate

Recommendation grade: Weak

Wound catheters and transversus abdominis plane block

Wound catheters and transversus abdominis plane (TAP) block offer the potential of incisional analgesia without the need for more invasive methods such as epidural analgesia (EDA). The technique offers an attractive alternative to EDA as peripheral block of afferent stress-mediating impulses is achieved without troublesome and potentially hazardous hypotension. Furthermore, the risk of complications such as epidural haematomas and abscess formation is avoided. Although there are no specific data regarding gastrectomy, several meta-analyses[47–49] have assessed the efficacy of wound infusion with local anaesthetic agents for postoperative analgesia after abdominal surgery in general. One meta-analysis[49], comprising a wide range of surgical procedures, including general surgical laparotomies, showed a significant reduction in postoperative pain, opioid consumption, as well as postoperative nausea and vomiting (PONV). Similarly, in patients undergoing colorectal surgery, there was a reduced use of opioids and reduction in length of hospital stay in patients randomized to preperitoneal wound catheter placement[50]. A more recent meta-analysis[47] did not, however, show any effect of wound infusion with regard to postoperative pain intensity or in opioid consumption after laparotomy. The inconsistency in results may reflect the heterogeneity in techniques used, including catheter placement (subcutaneous, subfascial, preperitoneal), and type, concentration and dose of local anaesthetic. No differences in risk of infectious complications were found between patients in whom a wound catheter was used and those managed without one[47,49–51].

Several RCTs and meta-analyses[52–55] have suggested a significant reduction in postoperative pain and opioid consumption during the first 24–48 h after surgery with the use of TAP blocks. There are no studies specifically addressing gastrectomy and most procedures included in these trials, such as cholecystectomies, appendicectomies and caesarean sections, are indeed less invasive, with regard to both abdominal wall incision and extent of internal dissection, than open gastrectomy for cancer[52–55]. Another limitation of TAP blocks in postgastrectomy analgesia is that there is no evidence of an effect exceeding the first 48 h after operation[52–55]. None of the studies available has suggested an increased risk of infection related to TAP blocks[52–55]. One RCT[56] comparing wound infiltration and patient-controlled analgesia (PCA) using opiates with EDA after open liver resection found that the latter conferred superior analgesia but not faster mobilization or recovery.

Summary and recommendation

Evidence is strong in support of TAP blocks for abdominal surgery in general, although the effect is evident only during the first 48 h after surgery and none of the evidence is from gastrectomies.

Evidence level: Wound catheters – Low to moderate
TAP blocks – Low

Recommendation grade: Weak

Nasogastric/nasojejunal decompression

Nine RCTs[8,57–64] and two meta-analyses[65,66] have specifically studied nasogastric/nasojejunal tubes in gastrectomies. One RCT[61] not included in the published meta-analyses showed results compatible with those from the RCTs and meta-analyses. A Cochrane review[67] evaluated nasogastric/nasojejunal tubes after several types of operation with a subgroup analysis dedicated to 'gastroduodenal operations'.

There is strong evidence against the routine use of nasogastric/nasojejunal decompression following gastrectomy. Surgical morbidity was not significantly influenced by decompression[65–67]. The most recent of the meta-analyses[65] and the Cochrane review[67] concluded that patients without routine decompression experienced significantly fewer pulmonary complications, earlier time to passage of flatus, earlier time to oral diet and shorter hospital stay. This was not confirmed in another meta-analysis[66].

Summary and recommendation

Nasogastric/nasojejunal tubes should not be used routinely in the setting of enhanced recovery protocols in gastric surgery.

Evidence level: High

Recommendation grade: Strong

Perianastomotic drains

Two RCTs[68,69] including a total of 278 patients treated by subtotal gastrectomy with D1 or D2 lymphadenectomy found no difference in postoperative course in terms of time to passage of flatus, intake of soft diet or length of hospital stay between patients in whom drains were or were not used. Postoperative complication rates at 30 days were also similar[68,69]. Another RCT[70] with 60 patients undergoing D2 gastrectomy found that the group with drains experienced longer hospital stays, higher postoperative morbidity with more frequent reoperations, and longer time to oral intake.

A meta-analysis of four RCTs[71] including 438 patients randomized to either perianastomotic drain or no drain found no differences between the groups with respect to wound infection, postoperative pulmonary infection, intra-abdominal abscess, mortality, time to flatus, and initiation of soft diet. Both incidence of postoperative complications and length of stay were lower in the no-drain group. A Cochrane analysis[72] concluded that there was no convincing evidence to support routine use of postoperative drains after gastrectomy for gastric cancer.

Summary and recommendation

Avoiding the use of abdominal drains may reduce drain-related complications and shorten hospital stay after gastrectomy.
Evidence level: High
Recommendation grade: Strong

Early postoperative diet and artificial nutrition

Patients subjected to total gastrectomy are probably at greater risk of malnutrition and cachexia at the time of surgery than other groups of patients with abdominal cancer[19]. This may result both from the location of their tumours, but also following neoadjuvant chemotherapy in a large proportion of the patients. A nil-by-mouth regimen for several days after surgery has traditionally been used for these patients[73]. The absence of a gastric remnant has its advantages, but oesophagojejunostomy is probably a more vulnerable reconstruction than that following a distal or subtotal gastric resection. Most trials challenging the ubiquitous nil-by-mouth routine have done so in the setting of distal gastrectomy[74,75] or only partly, introducing light food on postoperative day (POD) 2[9,76,77]. Data from Western centres are scant. A large Norwegian multicentre trial[78] randomized patients undergoing major upper gastrointestinal and HPB surgery to food at will from POD 1. Of 447 patients included, 77 had undergone total gastrectomy and a significant reduction in the number of intra-abdominal abscesses was demonstrated for those allowed food at will in this subgroup[78]. Importantly, no trial has reported any adverse outcome from any attempt at introducing patient-controlled or early introduction of food for patients undergoing gastrectomy.

It may be assumed that total calorie intake is low for the first few days and that some patients will need additional sip feeds or artificial tube or catheter feeding. A recent educational review[79] on nutritional care for patients undergoing oesophageal and gastric surgery recommends nutritional support after operation in patients who have not reached 60 per cent of desired intake by the first week following surgery[79]. Nutritional support should preferably be by high-energy oral sip feeds. Enteral tube feeding is indicated where oral intake is not possible, and parenteral nutrition only when the gut is not working or is inaccessible. Although robust data are lacking, it appears pragmatic and safe to provide more intensive nutritional support both before and after operation to severely malnourished patients.

Summary and recommendation

Patients undergoing total gastrectomy should be offered drink and food at will from POD 1. They should be advised to begin cautiously and increase intake according to tolerance.
Evidence level: Moderate
Recommendation grade: Weak

Patients clearly malnourished or those unable to meet 60 per cent of daily requirements by POD 6 should be given individualized nutritional support, as detailed above.
Evidence level: Moderate
Recommendation grade: Strong

Audit

Regular audit is crucial to determine clinical outcome, and ascertain the implementation and sustained use of a care protocol. There are indications that audit in itself improves clinical results through feedback[80] and several real-time graphical methods are now available to monitor surgical treatment outcomes of gastro-oesophageal surgery[81,82]. It is vital to distinguish between unsuccessful implementation and lack of desired effect from an implemented protocol if results are short of the desired quality standards. Multi-institutional agreement on a common evidence-based treatment platform and joint use of a prospective database is a powerful tool for audit and research.

Summary and recommendation

Systematic audit improves compliance and clinical outcomes.
Evidence level: Low
Recommendation grade: Strong

RESULTS PART 2: GENERAL (NOT PROCEDURE-SPECIFIC) ITEMS

The author group found that the data and recommendations published recently for patients undergoing pancreaticoduodenectomy seem valid for gastrectomy[3,6]. In the following sections these recommendations are reiterated and the background for each recommendation is addressed briefly. For a fuller consideration of the available literature with expanded references, the reader is referred to the aforementioned publications[3,6]. A summary of the general items is shown in *Table 2*.

Preoperative counselling

Personalized counselling, oral or written, and relaxation techniques may reduce anxiety and fear and improve recovery[83–86]. Detailed explanations of procedure and specific daily targets for the postoperative period may facilitate eating, mobilization, pain control and respiratory function, thus reducing the risk of complications[87–90].

Summary and recommendation

Patients should receive dedicated preoperative counselling routinely.

Evidence level: Low

Recommendation grade: Strong

Preoperative smoking and alcohol consumption

Overall postoperative morbidity is increased markedly in alcohol abusers[91], and 4 weeks of abstinence before surgery was shown to improve outcome in patients who drank 'five or more drinks (60 g of ethanol) a day without clinical or historical evidence of alcohol related illness'[92]. Daily smokers have an increased risk of complications[93,94]. RCTs[94–96] have shown reduced postoperative morbidity after 1 month of smoking cessation. Preoperative physiotherapy reduces postoperative pulmonary complications and length of hospital stay after elective cardiac surgery[97], and preoperative pulmonary rehabilitation before lung cancer surgery decreases postoperative respiratory morbidity and complications[98,99].

Summary and recommendation

For alcohol abusers, 1 month of abstinence before surgery is beneficial. For daily smokers, 1 month of abstinence before surgery is beneficial. For appropriate groups, both should be attempted. Preoperative pulmonary rehabilitation is advised.

Evidence level: Alcohol abstention – Low
Smoking cessation – Moderate

Recommendation grade: Strong

Oral bowel preparation

Mechanical bowel preparation (MBP) may cause dehydration, and fluid and electrolyte imbalance, especially in the elderly[100]. Meta-analyses[101,102] of trials on patients undergoing colonic surgery have not shown MBP to be beneficial. There are no data comparing MBP *versus* a routine without MBP and unrestricted diet up to midnight before operation.

Summary and recommendation

Extrapolation of data from colonic surgery suggests that MBP has no proven benefit. MBP should not be used.

Evidence level: Moderate

Recommendation grade: Strong

Preoperative fasting and preoperative treatment with carbohydrates

Fasting from midnight is not supported by evidence[103], and increases insulin resistance and discomfort following abdominal surgery[104,105]. Guidelines[106] recommend intake of clear fluids up to 2 h before induction of anaesthesia and solids up to 6 h. A complex clear carbohydrate-rich drink designed for use within 2 h before anaesthesia reduced hunger, thirst, anxiety and length of stay, as well as postoperative insulin resistance[107–109]. The most recent meta-analysis[110] showed no reduction in in-hospital complication rates. Data on patients having gastrectomy are inadequate[110], and data for diabetic patients are wanting[111,112].

Summary and recommendation

Preoperative fasting should be limited to 2 h for clear fluids and 6 h for solids. Data extrapolation from studies in major surgery suggests that preoperative oral carbohydrate treatment should be given to patients without diabetes.

Evidence level: Fluid intake – High
Solid intake – Low
Carbohydrate loading – Low

Recommendation grade: Fasting – Strong
Carbohydrate loading – Strong

Preanaesthetic medication

Reduced postoperative pain has not been demonstrated following pre-emptive use of analgesics[113], but medications for chronic pain should be continued around the time of operation. Preinduction anxiolytic medication might increase sedation on POD 1[114,115], and benefits are uncertain. Short-acting drugs to alleviate anxiety may be

Table 2 General (not procedure-specific) enhanced recovery care items as suggested recently for pancreaticoduodenectomy

	Summary and recommendations	Evidence level	Recommendation grade
Preoperative counselling	Patients should receive dedicated preoperative counselling routinely	Low	Strong
Preoperative smoking and alcohol consumption	For alcohol abusers, 1 month of abstinence before surgery is beneficial and should be attempted	Alcohol abstention: Low	Strong
	For daily smokers, 1 month of abstinence before surgery is beneficial	Smoking cessation: Moderate	
	For appropriate groups, both should be attempted		
Oral bowel preparation	Extrapolation of data from studies on colonic surgery shows that MBP has no proven benefit; MBP should not be used	Moderate	Strong
Preoperative fasting and preoperative treatment with carbohydrates	Intake of clear fluids ≤ 2 h before anaesthesia does not increase gastric residual volume and is recommended before elective surgery	Fluid intake: High	
	Intake of solids should be withheld 6 h before anaesthesia	Solid intake: Low	Fasting: Strong
	Data extrapolation from studies on major surgery suggests that preoperative oral carbohydrate treatment should be given to patients without diabetes	Carbohydrate loading: Low	Carbohydrate loading: Strong
Preanaesthetic medication	Data from studies on abdominal surgery show no evidence of clinical benefit from preoperative use of long-acting sedatives, and they should not be used routinely	No long-acting sedatives: Moderate	Weak
	Short-acting anxiolytics may be used for procedures such as insertion of epidural catheters		
Antithrombotic prophylaxis	LMWH reduces the risk of thromboembolic complications. Concomitant use of epidural analgesia necessitates close adherence to safety guidelines. Mechanical measures should probably be added for patients at high risk	High	Strong
Antimicrobial prophylaxis and skin preparation	Antimicrobial prophylaxis prevents surgical-site infections, and should be used in a single-dose manner initiated within 1 h before skin incision. Repeated intraoperative doses may be necessary depending on the half-life of the drug and duration of procedure	High	Strong
Epidural analgesia	Mid-thoracic epidurals are recommended based on data from studies on major open abdominal surgery showing superior pain relief and fewer respiratory complications compared with use of intravenous opioids	Pain: High Reduced respiratory complications: Moderate Overall morbidity: Low	Weak
Intravenous analgesia	Some evidence supports the use of PCA or intravenous lidocaine analgesic methods	PCA: Moderate Intravenous lidocaine: Moderate	Weak
Anaesthetic management	Short-acting anaesthetic drugs and short-acting muscle relaxants are suggested. Titration of anaesthetic agents can be achieved using the BIS	BIS: High	Strong
	Low-tidal volume ventilation is suggested	Low-tidal volume ventilation: High	

Table 2 Continued

	Summary and recommendations	Evidence level	Recommendation grade
PONV	Data from the literature on gastrointestinal surgery in patients at risk of PONV show the benefits of using different pharmacological agents depending on the patient's PONV history, type of surgery and type of anaesthesia. Multimodal intervention during and after surgery is indicated	Low	Strong
Avoiding hypothermia	Intraoperative hypothermia should be avoided by using cutaneous warming, i.e. forced-air or circulating-water garment systems	High	Strong
Postoperative glycaemic control	Insulin resistance and hyperglycaemia are strongly associated with postoperative morbidity and mortality. Treatment of hyperglycaemia with intravenous insulin in the ICU improves outcomes but hypoglycaemia remains a risk. Several enhanced recovery protocol items attenuate insulin resistance and facilitate glycaemic control without the risk of hypoglycaemia. Hyperglycaemia should be avoided as far as possible without introducing the risk of hypoglycaemia	Low	Strong
Fluid balance	Near-zero fluid balance, avoiding overload of salt and water results in improved outcomes	Fluid balance: High	Strong
	Perioperative monitoring of stroke volume with transoesophageal Doppler to optimize cardiac output with fluid boluses may improve outcomes	Oesophageal Doppler: Moderate	
	Balanced crystalloids should be preferred to 0·9% saline	Balanced crystalloids *versus* 0·9% saline: Moderate	
Urinary drainage	Suprapubic catheterization is superior to transurethral catheterization if used for > 4 days. Transurethral catheters can be removed safely on POD 1–2 unless indicated otherwise	High	Suprapubic catheter use: Weak Removal of transurethral catheter on POD 1–2: Strong
Stimulation of bowel movement	A multimodal approach with epidural and near-zero fluid balance is recommended	Chewing gum: Low	Weak
	Oral laxatives given after surgery may accelerate gastrointestinal transit	Laxatives: Very low	
Early and scheduled mobilization	Patients should be mobilized actively from the morning of POD 1 and encouraged to meet daily targets for mobilization	Very low	Strong

In the absence of procedure-specific evidence for these items, the author group considers extrapolation of these recommendations to patients undergoing total gastrectomy to be safe and feasible. For discussion and references please see original papers[3,6]. MBP, mechanical bowel preparation; LMWH, low molecular weight heparin; PCA, patient-controlled analgesia; BIS, bispectral index; PONV, postoperative nausea and vomiting; ICU, intensive care unit; POD, postoperative day.

helpful during insertion of an epidural catheter in some patients. A carbohydrate-rich drink has also been shown to attenuate anxiety[108].

Summary and recommendation

Data from studies on abdominal surgery show no evidence of clinical benefit from preoperative use of long-acting sedatives, and they should not be used routinely. Short-acting anxiolytics may be used for procedures such as insertion of epidural catheters.

Evidence level: No long-acting sedatives – Moderate
Recommendation grade: Weak

Antithrombotic prophylaxis

A large tumour burden, major surgery, chemotherapy and prolonged periods of recumbency are risk factors for venous thromboembolism (VTE). Heparins are effective at preventing VTE[116] and fractionated low molecular weight heparin (LMWH) has better compliance (once-daily administration)[117]. Injections are usually started 2–12 h before surgery and continued until the patient is mobilized. Data even support postdischarge treatment for several weeks[118]. Use of LMWH and epidural catheters is

controversial[119–122] and a 12-h interval should probably separate LMWH and catheter insertion and removal[123]. Mechanical measures (intermittent pneumatic leg compression and elastic stockings) may provide additional benefits in patients at increased risk of VTE[124,125].

Summary and recommendation

LMWH reduces the risk of thromboembolic complications. Administration should probably be continued for 4 weeks after hospital discharge. Concomitant use of EDA necessitates close adherence to safety guidelines. Mechanical measures should probably be added for patients at high risk.

Evidence level: High

Recommendation grade: Strong

Antimicrobial prophylaxis and skin preparation

There is sufficient evidence to support the prescription of antimicrobial prophylaxis for major abdominal procedures[126,127]. Recent studies recommend prescription in a single-dose manner[127], usually advocated within 1 h before incision; however, recent data suggest that the timing may not be crucial[128]. An extra dose should be given every 3–4 h during the procedure if drugs with a short half-life are used[129]. The choice of antibiotic varies according to local guidelines, but should be different from the drug used for management of established infections. Skin preparation with a scrub of chlorhexidine–alcohol has been claimed to be superior to povidone–iodine in preventing surgical-site infections[130].

Summary and recommendation

Antimicrobial prophylaxis prevents surgical-site infections and should be used in a single-dose manner initiated before skin incision. Repeated intraoperative doses may be necessary depending on the half-life of the drug and duration of the procedure.

Evidence level: High

Recommendation grade: Strong

Epidural analgesia

Continuous EDA with or without opioids leads to significantly less postoperative pain than parenteral opioids after open abdominal surgery[131]. A Cochrane review[132] demonstrated that EDA is better than patient-controlled intravenous opioid analgesia in relieving pain 72 h after open abdominal surgery, and epidural administration of local anaesthetic led to a lower rate of ileus after laparotomy than systemic or epidural opioids[133]. EDA was also associated with fewer complications, as well as an improvement in pulmonary function, decreased risk of postoperative pneumonia, better arterial oxygenation after abdominal or thoracic surgery[134], and reduced insulin resistance[135]. Data from a recent RCT[136] indicate that, for patients undergoing gastrectomy for cancer specifically, patient-controlled EDA appears to result in superior pain relief and lower stress response than patient-controlled intravenous analgesia.

Adverse perfusion effects of EDA may be caused by prolonged and extended sympathetic block. This suggests that the beneficial effects of EDA can be preserved provided that the haemodynamic consequences are adequately controlled with vasopressors[137]. Concerns about negative effects on anastomotic healing have been raised after colorectal surgery, but one meta-analysis[138] did not identify differences in rates of anastomotic leakage between patients treated with postoperative local anaesthetic epidurals and those receiving systemic or epidural opioids. A potential drawback with EDA is that up to one-third of epidurals may not function adequately[139,140], possibly owing to catheter misplacement, inadequate dose or pump failure. For upper abdominal incisions, epidural catheters should be inserted between T5 and T8 root levels. Sensory block should be tested before induction of general anaesthesia. EDA should continue for 48 h and, after a successful stop test, replaced by oral multimodal analgesia. If needed, functioning epidural catheters may be used for a longer duration.

Summary and recommendation

Mid-thoracic epidurals are recommended based on data from studies of major open abdominal surgery showing superior pain relief and fewer respiratory complications compared with intravenous opioids.

Evidence level: Pain – High
Reduced respiratory complications – Moderate
Overall morbidity – Low

Recommendation grade: Weak

Intravenous analgesia

In situations where EDA cannot be employed, PCA with opioids is the most common alternative. In a clinical trial[141] of the use of PCA in patients undergoing distal pancreatectomy this was the only analgesia employed. No comments were made, however, on the impact of systemic analgesia on accelerating recovery. Intravenous infusion of lidocaine has analgesic, anti-inflammatory and antihyperalgesic properties, and has been assessed as an analgesic modality for abdominal surgery. A systematic review of eight trials[142]

showed a decrease in the duration of ileus, length of hospital stay, postoperative pain and adverse effects, compared with placebo. A recent RCT[143] in patients undergoing laparoscopic colorectal resection using the ERAS® programme showed no difference in return of gastrointestinal function and length of hospital stay between continuous infusion of lidocaine and thoracic EDA, whereas a recent RCT[144] in patients undergoing laparoscopic gastrectomy showed a reduction in postoperative fentanyl consumption and pain with preoperative and intraoperative injection of lidocaine by PCA.

Summary and recommendation

Some evidence supports the use of PCA or intravenous lidocaine analgesic methods.

Evidence level: PCA – Moderate
Intravenous lidocaine – Moderate

Recommendation grade: Weak

Anaesthetic management

Although no trials exist, short-acting induction anaesthesia agents such as propofol and dexmedetomidine, and opioids such as sufentanil and remifentanil, are widely used. Likewise, short-acting muscle relaxants are suggested. Deep neuromuscular block is usually necessary to ensure optimal access, particularly in laparoscopic surgery. Titration of anaesthetic agents can be achieved using the bispectral index (BIS), thereby avoiding sedation that is too deep, which can be harmful in elderly patients[145]. Recent data suggest that a significant benefit for postoperative morbidity can be achieved by intraoperative low-tidal-volume ventilation[146].

Summary and recommendation

Short-acting induction agents, opioids and muscle relaxants are recommended. Maintenance should be guided by the BIS. Low-tidal-volume ventilation is suggested.

Evidence level: BIS – High
Low-tidal-volume ventilation – High

Recommendation grade: Strong

Postoperative nausea and vomiting

A comparative non-randomized study[147] indicated that an enhanced recovery protocol with early mobilization, metoclopramide and removal of the nasogastric tube on POD 1 or 2 reduced the rate of PONV after pancreaticoduodenectomy. Until further evidence becomes available for gastric cancer surgery, the suggestions for patients undergoing colorectal surgery[10] should be applicable. Patients with two risk factors (non-smoker, female, a history of motion sickness (or PONV), postoperative administration of opioids)[148,149] should be given prophylaxis with dexamethasone upon induction or a serotonin receptor antagonist at the end of surgery[150]. High-risk individuals (3 risk factors) should receive general anaesthesia with propofol and remifentanil and no volatile anaesthetics, with dexamethasone 4–8 mg at the start of surgery, with the addition of a serotonin receptor antagonist or droperidol[150], or 25–50 mg metoclopramide 30–60 min before the end of surgery[151]. A possible risk of impaired anastomotic healing caused by single-dose dexamethasone or other perioperative steroids is of concern, but remains unclear[152–155].

Summary and recommendation

Data from the literature on gastrointestinal surgery in patients at risk of PONV show the benefits of using different pharmacological agents depending on the patient's history of PONV, type of surgery and type of anaesthesia. Multimodal intervention, during and after surgery, is indicated.

Evidence level: Low

Recommendation grade: Strong

Avoiding hypothermia

Numerous meta-analyses and RCTs have shown that preventing hypothermia during major abdominal surgery reduces the occurrence of wound infections[156,157], cardiac complications[157–159], bleeding and transfusion requirements[157–160], as well as the duration of postanaesthetic recovery[161]. Prolonging systemic warming in the perioperative period (2 h before and after surgery) confers further benefits[162]. There is even evidence to conclude that circulating-water garments offer superior temperature control to forced-air warming systems[163–165].

Summary and recommendation

Intraoperative hypothermia should be avoided by using cutaneous warming in the form of forced-air or circulating-water garment systems.

Evidence level: High

Recommendation grade: Strong

Postoperative glycaemic control

Morbidity and mortality after major gastrointestinal surgery are associated with insulin resistance[166] and plasma glucose levels[167]. Treatment of hyperglycaemia

with intravenous insulin in the intensive care setting improves outcomes, although hypoglycaemia remains a risk. Core elements of enhanced recovery protocols alleviate postoperative insulin resistance and, therefore, also lower glucose concentrations[168,169]. The most evident protocol items are: avoidance of preoperative fasting and oral bowel preparation; use of oral carbohydrate treatment and stimulation of gut function by optimal fluid balance and avoidance of systemic opioids; and reduction of the stress response by use of EDA. Target thresholds for glucose are disputed, but glucosuria with the risk of hypovolaemia will ensue when the renal threshold is exceeded at 12 mmol/l[170]. This level has been used as the control regimen in seminal studies[171,172] and should probably be regarded as a limit, irrespective of settings.

Summary and recommendation

Insulin resistance and hyperglycaemia are strongly associated with postoperative morbidity and mortality. Hyperglycaemia should be avoided as far as possible without introducing the risk of hypoglycaemia.

Evidence level: Low

Recommendation grade: Strong

Fluid balance

Overload of salt and water, and hypovolaemia in the perioperative period all increase postoperative complication rates[173–177], suggesting that near-zero fluid balance should be achieved around the time of surgery. Determining the correct amount required is complicated by the use of EDA as it causes vasodilatation and hypovolaemia with hypotension, often diagnosed and treated as fluid depletion. This may result in the administration of unnecessary and large volumes of fluid[178]. To avoid unnecessary fluid overload, vasopressors should be considered for intraoperative and postoperative management of epidural-induced hypotension, bearing in mind the risk of drug-induced splanchnic vasoconstriction[179]. Several cardiac output monitoring devices provide dynamic indicators of fluid responsiveness and haemodynamic assessment. These vary from invasive pulmonary artery catheters to non-invasive pulse pressure analysis, bioimpedance, applied Fick principle and Doppler imaging[180]. Intraoperative flow-guided fluid therapy with transoesophageal Doppler ultrasonography to assess and monitor fluid status accurately has been shown to reduce complications and length of hospital stay after major abdominal surgery[181,182]. All devices providing haemodynamic surveillance show only whether an increase in fluids infused actually leads to improved cardiac output, and not whether the patient actually has hypoperfusion in need of treatment. Data for high-risk patients (American Society of Anesthesiologists grade III) are lacking. Excessive use of 0·9 per cent saline leads to an increase in postoperative complications compared with balanced crystalloids[183–185]. Although use of colloids results in improved blood volume expansion and less interstitial space overload than administration of crystalloids[186], there is no evidence from clinical trials or meta-analyses that they contribute to better clinical outcome[187].

Summary and recommendation

Near-zero fluid balance as well as avoiding overload of sodium results in improved outcomes. High-risk patients need dedicated, individualized, goal-directed fluid therapy handled by an experienced team to secure optimal tissue perfusion. A Doppler-guided technique may improve outcome. Balanced crystalloids should be preferred to 0·9 per cent saline.

Evidence level: Fluid balance – High
Oesophageal Doppler – Moderate
Balanced crystalloids *versus* 0·9 per cent saline – Moderate

Recommendation grade: Strong

Urinary drainage

A meta-analysis[188] of RCTs on urinary drainage after surgery showed that suprapubic catheterization was better than transurethral catheterization, and more satisfactory to patients. However, the majority of patients were catheterized for 4 days or longer. A recent RCT[189] of patients undergoing major surgery with thoracic epidurals found that removal of the transurethral catheter on POD 1 led to lower infection rates and did not lead to an increased rate of recatheterization compared with removal on POD 3–5.

Summary and recommendation

Suprapubic catheterization is probably superior to transurethral catheterization if used for more than 4 days. Transurethral catheters can be removed safely on POD 1 or 2 unless indicated otherwise.

Evidence level: High

Recommendation grade: Suprapubic catheter use – Weak
Removal of transurethral catheter on POD 1–2 – Strong

Stimulation of bowel movement

There is no high-level evidence to support a precise motility-enhancing drug. The use of oral laxatives such

as magnesium sulphate or bisacodyl may stimulate early gastrointestinal transit after colonic resections[190,191]. Use of epidurals and maintaining a near-zero fluid balance are associated with an enhanced return of peristalsis after abdominal surgery[133,175]. Chewing gum has been shown to be safe and helpful in restoring gut activity after colorectal surgery in one meta-analysis[192]. This was, however, not confirmed in recent RCTs[193,194].

Summary and recommendation

A multimodal approach with epidural and near-zero fluid balance is recommended. Oral laxatives given after surgery may accelerate gastrointestinal transit.

Evidence level: Laxatives – Very low
Chewing gum – Low

Recommendation grade: Weak

Early and scheduled mobilization

Delayed resumption of gut function combined with surgical trauma leads to a lengthened recovery period in patients undergoing major gastrointestinal surgery. Extended bed rest is associated with several unwanted effects[195,196]. With little evidence, the present authors support the use of written day-to-day instructions for patients with detailed postoperative targets. This improves autonomy and cooperation with patients. Day-to-day progress can be documented with simple monitoring devices. Analgesia must be adequate.

Summary and recommendation

Patients should be mobilized actively from the morning of POD 1 and encouraged to meet daily targets for mobilization.

Evidence level: Very low

Recommendation grade: Strong

Comments

A comprehensive set of guidelines for enhanced recovery after gastrectomy for cancer is presented. Although the magnitude of effect following the successful implementation of these guidelines is yet to be established, they represent an opportunity to apply the best available, updated perioperative practice to a group of patients at high risk of complications and morbidity.

For many of the items included, evidence is scarce and of low quality, and the use of a consensus-based process by an international author group is an attempt to minimize these shortcomings.

Consensus was unproblematic for most of the procedure-specific items covered in these guidelines, with the exception of PN and access. Literature on the former subject is incongruent and further high-quality RCTs with single-component administration in enhanced recovery settings are needed to reach more definite conclusions and recommendations. The subject of access is complex. Although there is an abundance of literature confirming perioperative benefits of laparoscopic treatment and safety for distal gastrectomy, there is a significant learning curve and studies describing outcomes after total gastrectomy are still wanting. Furthermore, the oncological aspect of minimally invasive surgery for proximal gastric cancer remains largely undocumented in RCTs as literature reporting long-term survival after total gastrectomy is limited and further studies are needed. Comparing laparoscopic and open resections in RCTs is challenging owing to the skill-dependent nature of these interventions and consequently a predictably low validity of the results[197]. Implementation of minimally invasive surgery for the treatment of gastric cancer, nevertheless, offers a potential evolution in the postoperative clinical course of these patients.

A recent review[198] on enhanced recovery in upper gastrointestinal surgery calls for international guidelines with standardization of clinical pathways, allowing comparison of results between institutions and across nations. The present consensus-based guidelines for enhanced recovery after gastrectomy offer such a framework, allowing the establishment of multi-institutional prospective cohort registries.

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References

1 Varadhan KK, Neal KR, Dejong CH, Fearon KC, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. *Clin Nutr* 2010; **29**: 434–440.
2 Gustafsson UO, Scott MJ, Schwenk W, Demartines N, Roulin D, Francis N *et al.*; Enhanced Recovery After Surgery Society. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *Clin Nutr* 2012; **31**: 783–800.
3 Lassen K, Coolsen MM, Slim K, Carli F, de Aguilar-Nascimento JE, Schäfer M *et al.* Guidelines for perioperative care for pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *Clin Nutr* 2012; **31**: 817–830.
4 Nygren J, Thacker J, Carli F, Fearon KC, Norderval S, Lobo DN *et al.* Guidelines for perioperative care in elective rectal/pelvic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *Clin Nutr* 2012; **31**: 801–816.
5 Gustafsson UO, Scott MJ, Schwenk W, Demartines N, Roulin D, Francis N *et al.* Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *World J Surg* 2013; **37**: 259–284.
6 Lassen K, Coolsen MM, Slim K, Carli F, de Aguilar-Nascimento JE, Schafer M *et al.* Guidelines for perioperative care for pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *World J Surg* 2013; **37**: 240–258.
7 Nygren J, Thacker J, Carli F, Fearon KC, Norderval S, Lobo DN *et al.* Guidelines for perioperative care in elective rectal/pelvic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *World J Surg* 2013; **37**: 285–305.
8 Jiang ZW, Li JS, Wang ZM, Li N, Liu XX, Li WY *et al.* [The safety and efficiency of fast track surgery in gastric cancer patients undergoing D2 gastrectomy.] *Zhonghua Wai Ke Za Zhi* 2007; **45**: 1314–1317.
9 Yamada T, Hayashi T, Cho H, Yoshikawa T, Taniguchi H, Fukushima R *et al.* Usefulness of enhanced recovery after surgery protocol as compared with conventional perioperative care in gastric surgery. *Gastric Cancer* 2012; **15**: 34–41.
10 Lassen K, Soop M, Nygren J, Cox PB, Hendry PO, Spies C *et al.* Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery After Surgery (ERAS) Group recommendations. *Arch Surg* 2009; **144**: 961–969.
11 Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P *et al.* GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008; **336**: 924–926.
12 Guyatt GH, Oxman AD, Kunz R, Vist GE, Falck-Ytter Y, Schunemann HJ. What is 'quality of evidence' and why is it important to clinicians? *BMJ* 2008; **336**: 995–998.
13 Guyatt GH, Oxman AD, Kunz R, Falck-Ytter Y, Vist GE, Liberati A *et al.* Going from evidence to recommendations. *BMJ* 2008; **336**: 1049–1051.
14 Braga M, Ljungqvist O, Soeters P, Fearon K, Weimann A, Bozzetti F. ESPEN Guidelines on Parenteral Nutrition: surgery. *Clin Nutr* 2009; **28**: 378–386.
15 van Stijn MF, Korkic-Halilovic I, Bakker MS, van der Ploeg T, van Leeuwen PA, Houdijk AP. Preoperative nutrition status and postoperative outcome in elderly general surgery patients: a systematic review. *JPEN J Parenter Enteral Nutr* 2013; **37**: 37–43.
16 Grotenhuis BA, Wijnhoven BP, Grüne F, van Bommel J, Tilanus HW, van Lanschot JJ. Preoperative risk assessment and prevention of complications in patients with esophageal cancer. *J Surg Oncol* 2010; **101**: 270–278.
17 Heys SD, Schofield AC, Wahle KW, Garcia-Caballero M. Nutrition and the surgical patient: triumphs and challenges. *Surgeon* 2005; **3**: 139–144.
18 Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003; **22**: 321–336.
19 Mariette C, De Botton ML, Piessen G. Surgery in esophageal and gastric cancer patients: what is the role for nutrition support in your daily practice? *Ann Surg Oncol* 2012; **19**: 2128–2134.
20 Cerantola Y, Hübner M, Grass F, Demartines N, Schäfer M. Immunonutrition in gastrointestinal surgery. *Br J Surg* 2011; **98**: 37–48.
21 Chen B, Zhou Y, Yang P, Wan HW, Wu XT. Safety and efficacy of fish oil-enriched parenteral nutrition regimen on postoperative patients undergoing major abdominal surgery: a meta-analysis of randomized controlled trials. *JPEN J Parenter Enteral Nutr* 2010; **34**: 387–394.
22 Marik PE, Zaloga GP. Immunonutrition in high-risk surgical patients: a systematic review and analysis of the literature. *JPEN J Parenter Enteral Nutr* 2010; **34**: 378–386.
23 Marimuthu K, Varadhan KK, Ljungqvist O, Lobo DN. A meta-analysis of the effect of combinations of immune modulating nutrients on outcome in patients undergoing major open gastrointestinal surgery. *Ann Surg* 2012; **255**: 1060–1068.
24 Wang Y, Jiang ZM, Nolan MT, Jiang H, Han HR, Yu K *et al.* The impact of glutamine dipeptide-supplemented parenteral nutrition on outcomes of surgical patients: a meta-analysis of randomized clinical trials. *JPEN J Parenter Enteral Nutr* 2010; **34**: 521–529.

25 Wei C, Hua J, Bin C, Klassen K. Impact of lipid emulsion containing fish oil on outcomes of surgical patients: systematic review of randomized controlled trials from Europe and Asia. *Nutrition* 2010; **26**: 474–481.

26 Zhang Y, Gu Y, Guo T, Li Y, Cai H. Perioperative immunonutrition for gastrointestinal cancer: a systematic review of randomized controlled trials. *Surg Oncol* 2012; **21**: e87–e95.

27 Hubner M, Cerantola Y, Grass F, Bertrand PC, Schafer M, Demartines N. Preoperative immunonutrition in patients at nutritional risk: results of a double-blinded randomized clinical trial. *Eur J Clin Nutr* 2012; **66**: 850–855.

28 Farreras N, Artigas V, Cardona D, Rius X, Trias M, González JA. Effect of early postoperative enteral immunonutrition on wound healing in patients undergoing surgery for gastric cancer. *Clin Nutr* 2005; **24**: 55–65.

29 Mudge L, Isenring E, Jamieson GG. Immunonutrition in patients undergoing esophageal cancer resection. *Dis Esophagus* 2011; **24**: 160–165.

30 Lobo DN, Williams RN, Welch NT, Aloysius MM, Nunes QM, Padmanabhan J *et al.* Early postoperative jejunostomy feeding with an immune modulating diet in patients undergoing resectional surgery for upper gastrointestinal cancer: a prospective, randomized, controlled, double-blind study. *Clin Nutr* 2006; **25**: 716–726.

31 Fujitani K, Tsujinaka T, Fujita J, Miyashiro I, Imamura H, Kimura Y *et al.* Prospective randomized trial of preoperative enteral immunonutrition followed by elective total gastrectomy for gastric cancer. *Br J Surg* 2012; **99**: 621–629.

32 Sultan J, Griffin SM, Di FF, Kirby JA, Shenton BK, Seal CJ *et al.* Randomized clinical trial of omega-3 fatty acid-supplemented enteral nutrition *versus* standard enteral nutrition in patients undergoing oesophagogastric cancer surgery. *Br J Surg* 2012; **99**: 346–355.

33 Sano T, Aiko T. New Japanese classifications and treatment guidelines for gastric cancer: revision concepts and major revised points. *Gastric Cancer* 2011; **14**: 97–100.

34 Ding J, Liao GQ, Liu HL, Liu S, Tang J. Meta-analysis of laparoscopy-assisted distal gastrectomy with D2 lymph node dissection for gastric cancer. *J Surg Oncol* 2012; **105**: 297–303.

35 Memon MA, Khan S, Yunus RM, Barr R, Memon B. Meta-analysis of laparoscopic and open distal gastrectomy for gastric carcinoma. *Surg Endosc* 2008; **22**: 1781–1789.

36 Ohtani H, Tamamori Y, Noguchi K, Azuma T, Fujimoto S, Oba H *et al.* A meta-analysis of randomized controlled trials that compared laparoscopy-assisted and open distal gastrectomy for early gastric cancer. *J Gastrointest Surg* 2010; **14**: 958–964.

37 Viñuela EF, Gonen M, Brennan MF, Coit DG, Strong VE. Laparoscopic *versus* open distal gastrectomy for gastric cancer: a meta-analysis of randomized controlled trials and high-quality nonrandomized studies. *Ann Surg* 2012; **255**: 446–456.

38 Yakoub D, Athanasiou T, Tekkis P, Hanna GB. Laparoscopic assisted distal gastrectomy for early gastric cancer: is it an alternative to the open approach? *Surg Oncol* 2009; **18**: 322–333.

39 Zeng YK, Yang ZL, Peng JS, Lin HS, Cai L. Laparoscopy-assisted *versus* open distal gastrectomy for early gastric cancer: evidence from randomized and nonrandomized clinical trials. *Ann Surg* 2012; **256**: 39–52.

40 Cai J, Wei D, Gao CF, Zhang CS, Zhang H, Zhao T. A prospective randomized study comparing open *versus* laparoscopy-assisted D2 radical gastrectomy in advanced gastric cancer. *Dig Surg* 2011; **28**: 331–337.

41 Huscher CG, Mingoli A, Sgarzini G, Sansonetti A, Di Paola M, Recher A *et al.* Laparoscopic *versus* open subtotal gastrectomy for distal gastric cancer: five-year results of a randomized prospective trial. *Ann Surg* 2005; **241**: 232–237.

42 Lee JH, Han HS, Lee JH. A prospective randomized study comparing open *vs* laparoscopy-assisted distal gastrectomy in early gastric cancer: early results. *Surg Endosc* 2005; **19**: 168–173.

43 Bracale U, Rovani M, Bracale M, Pignata G, Corcione F, Pecchia L. Totally laparoscopic gastrectomy for gastric cancer: meta-analysis of short-term outcomes. *Minim Invasive Ther Allied Technol* 2012; **21**: 150–160.

44 Martínez-Ramos D, Miralles-Tena JM, Cuesta MA, Escrig-Sos J, Van der Peet D, Hoashi JS *et al.* Laparoscopy *versus* open surgery for advanced and resectable gastric cancer: a meta-analysis. *Rev Esp Enferm Dig* 2011; **103**: 133–141.

45 Wei HB, Wei B, Qi CL, Chen TF, Huang Y, Zheng ZH *et al.* Laparoscopic *versus* open gastrectomy with D2 lymph node dissection for gastric cancer: a meta-analysis. *Surg Laparosc Endosc Percutan Tech* 2011; **21**: 383–390.

46 Kim KM, An JY, Kim HI, Cheong JH, Hyung WJ, Noh SH. Major early complications following open, laparoscopic and robotic gastrectomy. *Br J Surg* 2012; **99**: 1681–1687.

47 Gupta A, Favaios S, Perniola A, Magnuson A, Berggren L. A meta-analysis of the efficacy of wound catheters for post-operative pain management. *Acta Anaesthesiol Scand* 2011; **55**: 785–796.

48 Karthikesalingam A, Walsh SR, Markar SR, Sadat U, Tang TY, Malata CM. Continuous wound infusion of local anaesthetic agents following colorectal surgery: systematic review and meta-analysis. *World J Gastroenterol* 2008; **14**: 5301–5305.

49 Liu SS, Richman JM, Thirlby RC, Wu CL. Efficacy of continuous wound catheters delivering local anesthetic for postoperative analgesia: a quantitative and qualitative systematic review of randomized controlled trials. *J Am Coll Surg* 2006; **203**: 914–932.

50 Beaussier M, El'Ayoubi H, Schiffer E, Rollin M, Parc Y, Mazoit JX *et al.* Continuous preperitoneal infusion of ropivacaine provides effective analgesia and accelerates recovery after colorectal surgery: a randomized,

double-blind, placebo-controlled study. *Anesthesiology* 2007; **107**: 461–468.
51 Yndgaard S, Holst P, Bjerre-Jepsen K, Thomsen CB, Struckmann J, Mogensen T. Subcutaneously *versus* subfascially administered lidocaine in pain treatment after inguinal herniotomy. *Anesth Analg* 1994; **79**: 324–327.
52 Charlton S, Cyna AM, Middleton P, Griffiths JD. Perioperative transversus abdominis plane (TAP) blocks for analgesia after abdominal surgery. *Cochrane Database Syst Rev* 2010; (12)CD007705.
53 Johns N, O'Neill S, Ventham NT, Barron F, Brady RR, Daniel T. Clinical effectiveness of transversus abdominis plane (TAP) block in abdominal surgery: a systematic review and meta-analysis. *Colorectal Dis* 2012; **14**: e635–e642.
54 Petersen PL, Mathiesen O, Torup H, Dahl JB. The transversus abdominis plane block: a valuable option for postoperative analgesia? A topical review. *Acta Anaesthesiol Scand* 2010; **54**: 529–535.
55 Siddiqui MR, Sajid MS, Uncles DR, Cheek L, Baig MK. A meta-analysis on the clinical effectiveness of transversus abdominis plane block. *J Clin Anesth* 2011; **23**: 7–14.
56 Revie EJ, McKeown DW, Wilson JA, Garden OJ, Wigmore SJ. Randomized clinical trial of local infiltration plus patient-controlled opiate analgesia *vs.* epidural analgesia following liver resection surgery. *HPB (Oxford)* 2012; **14**: 611–618.
57 Carrere N, Seulin P, Julio CH, Bloom E, Gouzi JL, Pradère B. Is nasogastric or nasojejunal decompression necessary after gastrectomy? A prospective randomized trial. *World J Surg* 2007; **31**: 122–127.
58 Doglietto GB, Papa V, Tortorelli AP, Bossola M, Covino M, Pacelli F. Nasojejunal tube placement after total gastrectomy: a multicenter prospective randomized trial. *Arch Surg* 2004; **139**: 1309–1313.
59 Hsu S, Yu J C, Chen T W, Chou S J, Hsieh H F, Chan DC. Role of nasogastric tube insertion after gastrectomy. *Chirurgische Gastroenterologie Interdisziplinar* 2007; **23**: 303–306.
60 Lee JH, Hyung WJ, Noh SH. Comparison of gastric cancer surgery with *versus* without nasogastric decompression. *Yonsei Med J* 2002; **43**: 451–456.
61 Li C, Mei JW, Yan M, Chen MM, Yao XX, Yang QM *et al.* Nasogastric decompression for radical gastrectomy for gastric cancer: a prospective randomized controlled study. *Dig Surg* 2011; **28**: 167–172.
62 Mei JW, Li C, Xiang M, Chen MM, Yao XX, Yang QM *et al.* [Evaluation of the gastrointestinal decompression after gastrectomy: a prospective randomized controlled trial.] *Zhonghua Wei Chang Wai Ke Za Zhi* 2009; **12**: 452–455.
63 Wu CC, Hwang CR, Liu TJ. There is no need for nasogastric decompression after partial gastrectomy with extensive lymphadenectomy. *Eur J Surg* 1994; **160**: 369–373.
64 Yoo CH, Son BH, Han WK, Pae WK. Nasogastric decompression is not necessary in operations for gastric cancer: prospective randomised trial. *Eur J Surg* 2002; **168**: 379–383.
65 Chen K, Mou YP, Xu XW, Xie K, Zhou W. [Necessity of routine nasogastric decompression after gastrectomy for gastric cancer: a meta-analysis.] *Zhonghua Yi Xue Za Zhi* 2012; **92**: 1841–1844.
66 Yang Z, Zheng Q, Wang Z. Meta-analysis of the need for nasogastric or nasojejunal decompression after gastrectomy for gastric cancer. *Br J Surg* 2008; **95**: 809–816.
67 Nelson R, Edwards S, Tse B. Prophylactic nasogastric decompression after abdominal surgery. *Cochrane Database Syst Rev* 2007; (3)CD004929.
68 Kumar M, Yang SB, Jaiswal VK, Shah JN, Shreshtha M, Gongal R. Is prophylactic placement of drains necessary after subtotal gastrectomy? *World J Gastroenterol* 2007; **13**: 3738–3741.
69 Kim J, Lee J, Hyung WJ, Cheong JH, Chen J, Choi SH *et al.* Gastric cancer surgery without drains: a prospective randomized trial. *J Gastrointest Surg* 2004; **8**: 727–732.
70 Alvarez Uslar R, Molina H, Torres O, Cancino A. Total gastrectomy with or without abdominal drains. A prospective randomized trial. *Rev Esp Enferm Dig* 2005; **97**: 562–569.
71 Liu HP, Zhang YC, Zhang YL, Yin LN, Wang J. Drain *versus* no-drain after gastrectomy for patients with advanced gastric cancer: systematic review and meta-analysis. *Dig Surg* 2011; **28**: 178–189.
72 Wang Z, Chen J, Su K, Dong Z. Abdominal drainage *versus* no drainage post gastrectomy for gastric cancer. *Cochrane Database Syst Rev* 2011; (8)CD008788.
73 Lassen K, Dejong CH, Ljungqvist O, Fearon K, Andersen J, Hannemann P *et al.* Nutritional support and oral intake after gastric resection in five northern European countries. *Dig Surg* 2005; **22**: 346–352.
74 Hirao M, Tsujinaka T, Takeno A, Fujitani K, Kurata M. Patient-controlled dietary schedule improves clinical outcome after gastrectomy for gastric cancer. *World J Surg* 2005; **29**: 853–857.
75 Hur H, Si Y, Kang WK, Kim W, Jeon HM. Effects of early oral feeding on surgical outcomes and recovery after curative surgery for gastric cancer: pilot study results. *World J Surg* 2009; **33**: 1454–1458.
76 Jo DH, Jeong O, Sun JW, Jeong MR, Ryu SY, Park YK. Feasibility study of early oral intake after gastrectomy for gastric carcinoma. *J Gastric Cancer* 2011; **11**: 101–108.
77 Suehiro T, Matsumata T, Shikada Y, Sugimachi K. Accelerated rehabilitation with early postoperative oral feeding following gastrectomy. *Hepatogastroenterology* 2004; **51**: 1852–1855.
78 Lassen K, Kjaeve J, Fetveit T, Tranø G, Sigurdsson HK, Horn A *et al.* Allowing normal food at will after major upper gastrointestinal surgery does not increase morbidity: a randomized multicenter trial. *Ann Surg* 2008; **247**: 721–729.

79 Mariette C, De Botton ML, Piessen G. Surgery in esophageal and gastric cancer patients: what is the role for nutrition support in your daily practice? *Ann Surg Oncol* 2012; **19**: 2128–2134.

80 Jamtvedt G, Young JM, Kristoffersen DT, Thomson O'Brien MA, Oxman AD. Audit and feedback: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev* 2003; (3)CD000259.

81 Collins GS, Jibawi A, McCulloch P. Control chart methods for monitoring surgical performance: a case study from gastro-oesophageal surgery. *Eur J Surg Oncol* 2011; **37**: 473–480.

82 Roberts G, Tang CB, Harvey M, Kadirkamanathan S. Real-time outcome monitoring following oesophagectomy using cumulative sum techniques. *World J Gastrointest Surg* 2012; **4**: 234–237.

83 Halaszynski TM, Juda R, Silverman DG. Optimizing postoperative outcomes with efficient preoperative assessment and management. *Crit Care Med* 2004; **32**(Suppl): S76–S86.

84 Carli F, Charlebois P, Baldini G, Cachero O, Stein B. An integrated multidisciplinary approach to implementation of a fast-track program for laparoscopic colorectal surgery. *Can J Anaesth* 2009; **56**: 837–842.

85 Stergiopoulou A, Birbas K, Katostaras T, Mantas J. The effect of interactive multimedia on preoperative knowledge and postoperative recovery of patients undergoing laparoscopic cholecystectomy. *Methods Inf Med* 2007; **46**: 406–409.

86 Broadbent E, Kahokehr A, Booth RJ, Thomas J, Windsor JA, Buchanan CM *et al.* A brief relaxation intervention reduces stress and improves surgical wound healing response: a randomised trial. *Brain Behav Immun* 2012; **26**: 212–217.

87 Edward GM, Naald NV, Oort FJ, de Haes HC, Biervliet JD, Hollmann MW *et al.* Information gain in patients using a multimedia website with tailored information on anaesthesia. *Br J Anaesth* 2011; **106**: 319–324.

88 Haines TP, Hill AM, Hill KD, McPhail S, Oliver D, Brauer S *et al.* Patient education to prevent falls among older hospital inpatients: a randomized controlled trial. *Arch Intern Med* 2011; **171**: 516–524.

89 Clarke HD, Timm VL, Goldberg BR, Hattrup SJ. Preoperative patient education reduces in-hospital falls after total knee arthroplasty. *Clin Orthop Relat Res* 2011; **470**: 244–249.

90 Stergiopoulou A, Birbas K, Katostaras T, Mantas J. The effect of interactive multimedia on preoperative knowledge and postoperative recovery of patients undergoing laparoscopic cholecystectomy. *Methods Inf Med* 2007; **46**: 406–409.

91 Tonnesen H, Kehlet H. Preoperative alcoholism and postoperative morbidity. *Br J Surg* 1999; **86**: 869–874.

92 Tonnesen H, Rosenberg J, Nielsen HJ, Rasmussen V, Hauge C, Pedersen IK *et al.* Effect of preoperative abstinence on poor postoperative outcome in alcohol misusers: randomised controlled trial. *BMJ* 1999; **318**: 1311–1316.

93 Bluman LG, Mosca L, Newman N, Simon DG. Preoperative smoking habits and postoperative pulmonary complications. *Chest* 1998; **113**: 883–889.

94 Sorensen LT, Karlsmark T, Gottrup F. Abstinence from smoking reduces incisional wound infection: a randomized controlled trial. *Ann Surg* 2003; **238**: 1–5.

95 Lindström D, Sadr Azodi O, Wladis A, Tønnesen H, Linder S, Nasell H *et al.* Effects of a perioperative smoking cessation intervention on postoperative complications: a randomized trial. *Ann Surg* 2008; **248**: 739–745.

96 Mastracci TM, Carli F, Finley RJ, Muccio S, Warner DO. Effect of preoperative smoking cessation interventions on postoperative complications. *J Am Coll Surg* 2011; **212**: 1094–1096.

97 Hulzebos EH, Smit Y, Helders PP, van Meeteren NL. Preoperative physical therapy for elective cardiac surgery patients. *Cochrane Database Syst Rev* 2012; (11)CD010118.

98 Harada H, Yamashita Y, Misumi K, Tsubokawa N, Nakao J, Matsutani J *et al.* Multidisciplinary team-based approach for comprehensive preoperative pulmonary rehabilitation including intensive nutritional support for lung cancer patients. *PLoS One* 2013; **8**: e59566.

99 Morano MT, Araujo AS, Nascimento FB, da Silva GF, Mesquita R, Pinto JS *et al.* Preoperative pulmonary rehabilitation *versus* chest physical therapy in patients undergoing lung cancer resection: a pilot randomized controlled trial. *Arch Phys Med Rehabil* 2013; **94**: 53–58.

100 Holte K, Nielsen KG, Madsen JL, Kehlet H. Physiologic effects of bowel preparation. *Dis Colon Rectum* 2004; **47**: 1397–1402.

101 Guenaga KF, Matos D, Castro AA, Atallah AN, Wille-Jørgensen P. Mechanical bowel preparation for elective colorectal surgery. *Cochrane Database Syst Rev* 2005; (1)CD001544.

102 Cao F, Li J, Li F. Mechanical bowel preparation for elective colorectal surgery: updated systematic review and meta-analysis. *Int J Colorectal Dis* 2011; **27**: 803–810.

103 Ljungqvist O, Søreide E. Preoperative fasting. *Br J Surg* 2003; **90**: 400–406.

104 Smith I, Kranke P, Murat I, Smith A, O'Sullivan G, Søreide E *et al.* Perioperative fasting in adults and children: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol* 2011; **28**: 556–569.

105 Svanfeldt M, Thorell A, Brismar K, Nygren J, Ljungqvist O. Effects of 3 days of 'postoperative' low caloric feeding with or without bed rest on insulin sensitivity in healthy subjects. *Clin Nutr* 2003; **22**: 31–38.

106 American Society of Anesthesiologists Committee. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: an updated report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters. *Anesthesiology* 2011; **114**: 495–511.

107 Ljungqvist O, Nygren J, Thorell A. Modulation of post-operative insulin resistance by pre-operative carbohydrate loading. *Proc Nutr Soc* 2002; **61**: 329–336.

108 Hausel J, Nygren J, Lagerkranser M, Hellstrom PM, Hammarqvist F, Almström C *et al.* A carbohydrate-rich drink reduces preoperative discomfort in elective surgery patients. *Anest Analg* 2001; **93**: 1344–1350.

109 Helminen H, Viitanen H, Sajanti J. Effect of preoperative intravenous carbohydrate loading on preoperative discomfort in elective surgery patients. *Eur J Anaesthesiol* 2009; **26**: 123–127.

110 Awad S, Varadhan KK, Ljungqvist O, Lobo DN. A meta-analysis of randomised controlled trials on preoperative oral carbohydrate treatment in elective surgery. *Clin Nutr* 2013; **32**: 34–44.

111 Gustafsson UO, Nygren J, Thorell A, Soop M, Hellstrom PM, Ljungqvist O *et al.* Pre-operative carbohydrate loading may be used in type 2 diabetes patients. *Acta Anaesthesiol Scand* 2008; **52**: 946–951.

112 Breuer JP, von Dossow V, von Heymann C, Griesbach M, von Schickfus M, Mackh E *et al.* Preoperative oral carbohydrate administration to ASA III–IV patients undergoing elective cardiac surgery. *Anesth Analg* 2006; **103**: 1099–1108.

113 Møiniche S, Kehlet H, Dahl JB. A qualitative and quantitative systematic review of preemptive analgesia for postoperative pain relief: the role of timing of analgesia. *Anesthesiology* 2002; **96**: 725–741.

114 Caumo W, Hidalgo MP, Schmidt AP, Iwamoto CW, Adamatti LC, Bergmann J *et al.* Effect of pre-operative anxiolysis on postoperative pain response in patients undergoing total abdominal hysterectomy. *Anaesthesia* 2002; **57**: 740–746.

115 Walker KJ, Smith AF. Premedication for anxiety in adult day surgery. *Cochrane Database Syst Rev* 2009; (4)CD002192.

116 Clagett GP, Anderson FA Jr, Geerts W, Heit JA, Knudson M, Lieberman JR *et al.* Prevention of venous thromboembolism. *Chest* 1998; **114**(Suppl): 531S–560S.

117 Koch A, Bouges S, Ziegler S, Dinkel H, Daures JP, Victor N. Low molecular weight heparin and unfractionated heparin in thrombosis prophylaxis after major surgical intervention: update of previous meta-analyses. *Br J Surg* 1997; **84**: 750–759.

118 Rasmussen MS, Jørgensen LN, Wille-Jørgensen P. Prolonged thromboprophylaxis with low molecular weight heparin for abdominal or pelvic surgery. *Cochrane Database Syst Rev* 2009; (1)CD004318.

119 Horlocker TT, Wedel DJ, Benzon H, Brown DL, Enneking FK, Heit JA *et al.* Regional anesthesia in the anticoagulated patient: defining the risks (the second ASRA Consensus Conference on Neuraxial Anesthesia and Anticoagulation). *Reg Anesth Pain Med* 2003; **28**: 172–197.

120 Horlocker TT, Wedel DJ, Rowlingson JC, Enneking FK, Kopp SL, Benzon HT *et al.* Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (Third Edition). *Reg Anesth Pain Med* 2010; **35**: 64–101.

121 Liu SS, Mulroy MF. Neuraxial anesthesia and analgesia in the presence of standard heparin. *Reg Anesth Pain Med* 1998; **23**(Suppl 2): 157–163.

122 Tryba M. European practice guidelines: thromboembolism prophylaxis and regional anesthesia. *Reg Anesth Pain Med* 1998; **23**(Suppl 2): 178–182.

123 Breivik H, Bang U, Jalonen J, Vigfússon G, Alahuhta S, Lagerkranser M. Nordic guidelines for neuraxial blocks in disturbed haemostasis from the Scandinavian Society of Anaesthesiology and Intensive Care Medicine. *Acta Anaesthesiol Scand* 2010; **54**: 16–41.

124 Kakkos SK, Caprini JA, Geroulakos G, Nicolaides AN, Stansby GP, Reddy DJ. Combined intermittent pneumatic leg compression and pharmacological prophylaxis for prevention of venous thromboembolism in high-risk patients. *Cochrane Database Syst Rev* 2008; (4)CD005258.

125 Lippi G, Favaloro EJ, Cervellin G. Prevention of venous thromboembolism: focus on mechanical prophylaxis. *Semin Thromb Hemost* 2011; **37**: 237–251.

126 Bratzler DW, Houck PM. Antimicrobial prophylaxis for surgery: an advisory statement from the National Surgical Infection Prevention Project. *Am J Surg* 2005; **189**: 395–404.

127 Nelson RL, Glenny AM, Song F. Antimicrobial prophylaxis for colorectal surgery. *Cochrane Database Syst Rev* 2009; (1)CD001181.

128 Hawn MT, Richman JS, Vick CC, Deierhoi RJ, Graham LA, Henderson WG *et al.* Timing of surgical antibiotic prophylaxis and the risk of surgical site infection. *JAMA Surg* 2013; **148**: 649–657.

129 Fujita S, Saito N, Yamada T, Takii Y, Kondo K, Ohue M *et al.* Randomized, multicenter trial of antibiotic prophylaxis in elective colorectal surgery: single dose *vs* 3 doses of a second-generation cephalosporin without metronidazole and oral antibiotics. *Arch Surg* 2007; **142**: 657–661.

130 Darouiche RO, Wall MJ Jr, Itani KM, Otterson MF, Webb AL, Carrick MM *et al.* Chlorhexidine–alcohol *versus* povidone–iodine for surgical-site antisepsis. *N Engl J Med* 2010; **362**: 18–26.

131 Block BM, Liu SS, Rowlingson AJ, Cowan AR, Cowan JA Jr, Wu CL. Efficacy of postoperative epidural analgesia: a meta-analysis. *JAMA* 2003; **290**: 2455–2463.

132 Werawatganon T, Charuluxanun S. Patient controlled intravenous opioid analgesia *versus* continuous epidural analgesia for pain after intra-abdominal surgery. *Cochrane Database Syst Rev* 2005; (1)CD004088.

133 Jørgensen H, Wetterslev J, Moiniche S, Dahl JB. Epidural local anaesthetics *versus* opioid-based analgesic regimens on postoperative gastrointestinal paralysis, PONV and pain after abdominal surgery. *Cochrane Database Syst Rev* 2000; (4)CD001893.

134 Popping DM, Elia N, Marret E, Remy C, Tramèr MR. Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery: a meta-analysis. *Arch Surg* 2008; **143**: 990–999.
135 Uchida I, Asoh T, Shirasaka C, Tsuji H. Effect of epidural analgesia on postoperative insulin resistance as evaluated by insulin clamp technique. *Br J Surg* 1988; **75**: 557–562.
136 Zhu Z, Wang C, Xu C, Cai Q. Influence of patient-controlled epidural analgesia *versus* patient-controlled intravenous analgesia on postoperative pain control and recovery after gastrectomy for gastric cancer: a prospective randomized trial. *Gastric Cancer* 2013; **16**: 193–200.
137 Hiltebrand LB, Koepfli E, Kimberger O, Sigurdsson GH, Brandt S. Hypotension during fluid-restricted abdominal surgery: effects of norepinephrine treatment on regional and microcirculatory blood flow in the intestinal tract. *Anesthesiology* 2011; **114**: 557–564.
138 Holte K, Kehlet H. Epidural analgesia and risk of anastomotic leakage. *Reg Anesth Pain Med* 2001; **26**: 111–117.
139 Burstal R, Wegener F, Hayes C, Lantry G. Epidural analgesia: prospective audit of 1062 patients. *Anaesth Intensive Care* 1998; **26**: 165–172.
140 McLeod G, Davies H, Munnoch N, Bannister J, MacRae W. Postoperative pain relief using thoracic epidural analgesia: outstanding success and disappointing failures. *Anaesthesia* 2001; **56**: 75–81.
141 Kennedy EP, Grenda TR, Sauter PK, Rosato EL, Chojnacki KA, Rosato FE Jr *et al.* Implementation of a critical pathway for distal pancreatectomy at an academic institution. *J Gastrointest Surg* 2009; **13**: 938–944.
142 Marret E, Rolin M, Beaussier M, Bonnet F. Meta-analysis of intravenous lidocaine and postoperative recovery after abdominal surgery. *Br J Surg* 2008; **95**: 1331–1338.
143 Wongyingsinn M, Baldini G, Charlebois P, Liberman S, Stein B, Carli F. Intravenous lidocaine *versus* thoracic epidural analgesia: a randomized controlled trial in patients undergoing laparoscopic colorectal surgery using an enhanced recovery program. *Reg Anesth Pain Med* 2011; **36**: 241–248.
144 Kim TH, Kang H, Choi YS, Park JM, Chi KC, Shin HY *et al.* Pre- and intraoperative lidocaine injection for preemptive analgesics in laparoscopic gastrectomy: a prospective, randomized, double-blind, placebo-controlled study. *J Laparoendosc Adv Surg Tech A* 2013; **23**: 663–668.
145 Punjasawadwong Y, Boonjeungmonkol N, Phongchiewboon A. Bispectral index for improving anaesthetic delivery and postoperative recovery. *Cochrane Database Syst Rev* 2007; (4)CD003843.
146 Futier E, Constantin JM, Paugam-Burtz C, Pascal J, Eurin M, Neuschwander A *et al.* A trial of intraoperative low-tidal-volume ventilation in abdominal surgery. *N Engl J Med* 2013; **369**: 428–437.
147 Balzano G, Zerbi A, Braga M, Rocchetti S, Beneduce AA, Di Carlo V. Fast-track recovery programme after pancreatico-duodenectomy reduces delayed gastric emptying. *Br J Surg* 2008; **95**: 1387–1393.
148 Apfel CC, Kranke P, Eberhart LH, Roos A, Roewer N. Comparison of predictive models for postoperative nausea and vomiting. *Br J Anaesth* 2002; **88**: 234–240.
149 Rusch D, Eberhart L, Biedler A, Dethling J, Apfel CC. Prospective application of a simplified risk score to prevent postoperative nausea and vomiting. *Can J Anaesth* 2005; **52**: 478–484.
150 Carlisle JB, Stevenson CA. Drugs for preventing postoperative nausea and vomiting. *Cochrane Database Syst Rev* 2006; (3)CD004125.
151 Wallenborn J, Gelbrich G, Bulst D, Behrends K, Wallenborn H, Rohrbach A *et al.* Prevention of postoperative nausea and vomiting by metoclopramide combined with dexamethasone: randomised double blind multicentre trial. *BMJ* 2006; **333**: 324.
152 De Oliveira GS Jr, Almeida MD, Benzon HT, McCarthy RJ. Perioperative single dose systemic dexamethasone for postoperative pain: a meta-analysis of randomized controlled trials. *Anesthesiology* 2011; **115**: 575–588.
153 Engelman E, Maeyens C. Effect of preoperative single-dose corticosteroid administration on postoperative morbidity following esophagectomy. *J Gastrointest Surg* 2010; **14**: 788–804.
154 Eubanks TR, Greenberg JJ, Dobrin PB, Harford FJ, Gamelli RL. The effects of different corticosteroids on the healing colon anastomosis and cecum in a rat model. *Am Surg* 1997; **63**: 266–269.
155 Polat A, Nayci A, Polat G, Aksöyek S. Dexamethasone down-regulates endothelial expression of intercellular adhesion molecule and impairs the healing of bowel anastomoses. *Eur J Surg* 2002; **168**: 500–506.
156 Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Engl J Med* 1996; **334**: 1209–1215.
157 Scott EM, Buckland R. A systematic review of intraoperative warming to prevent postoperative complications. *AORN J* 2006; **83**: 1090–1113.
158 Frank SM, Fleisher LA, Breslow MJ, Higgins MS, Olson KF, Kelly S *et al.* Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events. A randomized clinical trial. *JAMA* 1997; **277**: 1127–1134.
159 Nesher N, Zisman E, Wolf T, Sharony R, Bolotin G, David M *et al.* Strict thermoregulation attenuates myocardial injury during coronary artery bypass graft surgery as reflected by reduced levels of cardiac-specific troponin I. *Anesth Analg* 2003; **96**: 328–335.
160 Rajagopalan S, Mascha E, Na J, Sessler DI. The effects of mild perioperative hypothermia on blood loss and transfusion requirement. *Anesthesiology* 2008; **108**: 71–77.
161 Lenhardt R, Marker E, Goll V, Tschernich H, Kurz A, Sessler DI *et al.* Mild intraoperative hypothermia prolongs

postanesthetic recovery. *Anesthesiology* 1997; **87**: 1318–1323.
162 Wong PF, Kumar S, Bohra A, Whetter D, Leaper DJ. Randomized clinical trial of perioperative systemic warming in major elective abdominal surgery. *Br J Surg* 2007; **94**: 421–426.
163 Galvão CM, Liang Y, Clark AM. Effectiveness of cutaneous warming systems on temperature control: meta-analysis. *J Adv Nurs* 2010; **66**: 1196–1206.
164 Perez-Protto S, Sessler DI, Reynolds LF, Bakri MH, Mascha E, Cywinski J *et al.* Circulating-water garment or the combination of a circulating-water mattress and forced-air cover to maintain core temperature during major upper-abdominal surgery. *Br J Anaesth* 2010; **105**: 466–470.
165 Taguchi A, Ratnaraj J, Kabon B, Sharma N, Lenhardt R, Sessler DI *et al.* Effects of a circulating-water garment and forced-air warming on body heat content and core temperature. *Anesthesiology* 2004; **100**: 1058–1064.
166 Sato H, Carvalho G, Sato T, Lattermann R, Matsukawa T, Schricker T. The association of preoperative glycemic control, intraoperative insulin sensitivity, and outcomes after cardiac surgery. *J Clin Endocrinol Metab* 2010; **95**: 4338–4344.
167 Jackson RS, Amdur RL, White JC, Macsata RA. Hyperglycemia is associated with increased risk of morbidity and mortality after colectomy for cancer. *J Am Coll Surg* 2012; **214**: 68–80.
168 Ljungqvist O. Insulin resistance and outcomes in surgery. *J Clin Endocrinol Metab* 2010; **95**: 4217–4219.
169 Ljungqvist O, Jonathan E. Rhoads lecture 2011: Insulin resistance and enhanced recovery after surgery. *JPEN J Parenter Enteral Nutr* 2012; **36**: 389–398.
170 Van den Berghe G, Schetz M, Vlasselaers D, Hermans G, Wilmer A, Bouillon R *et al.* Clinical review: Intensive insulin therapy in critically ill patients: NICE-SUGAR or Leuven blood glucose target? *J Clin Endocrinol Metab* 2009; **94**: 3163–3170.
171 van den Berghe G, Wouters P, Weekers F, Verwaest C, Bruyninckx F, Schetz M *et al.* Intensive insulin therapy in critically ill patients. *N Engl J Med* 2001; **345**: 1359–1367.
172 Van den Berghe G, Wilmer A, Hermans G, Meersseman W, Wouters PJ, Milants I *et al.* Intensive insulin therapy in the medical ICU. *N Engl J Med* 2006; **354**: 449–461.
173 Brandstrup B, Tønnesen H, Beier-Holgersen R, Hjortso E, Ørding H, Lindorff-Larsen K *et al.* Effects of intravenous fluid restriction on postoperative complications: comparison of two perioperative fluid regimens: a randomized assessor-blinded multicenter trial. *Ann Surg* 2003; **238**: 641–648.
174 Chowdhury AH, Lobo DN. Fluids and gastrointestinal function. *Curr Opin Clin Nutr Metab Care* 2011; **14**: 469–476.
175 Lobo DN, Bostock KA, Neal KR, Perkins AC, Rowlands BJ, Allison SP. Effect of salt and water balance on recovery of gastrointestinal function after elective colonic resection: a randomised controlled trial. *Lancet* 2002; **359**: 1812–1818.
176 Lobo DN. Fluid overload and surgical outcome: another piece in the jigsaw. *Ann Surg* 2009; **249**: 186–188.
177 Varadhan KK, Lobo DN. A meta-analysis of randomised controlled trials of intravenous fluid therapy in major elective open abdominal surgery: getting the balance right. *Proc Nutr Soc* 2010; **69**: 488–498.
178 Holte K, Foss NB, Svensén C, Lund C, Madsen JL, Kehlet H. Epidural anesthesia, hypotension, and changes in intravascular volume. *Anesthesiology* 2004; **100**: 281–286.
179 Low J, Johnston N, Morris C. Epidural analgesia: first do no harm. *Anaesthesia* 2008; **63**: 1–3.
180 Alhashemi JA, Cecconi M, Hofer CK. Cardiac output monitoring: an integrative perspective. *Crit Care* 2011; **15**: 214.
181 Abbas SM, Hill AG. Systematic review of the literature for the use of oesophageal Doppler monitor for fluid replacement in major abdominal surgery. *Anaesthesia* 2008; **63**: 44–51.
182 Giglio MT, Marucci M, Testini M, Brienza N. Goal-directed haemodynamic therapy and gastrointestinal complications in major surgery: a meta-analysis of randomized controlled trials. *Br J Anaesth* 2009; **103**: 637–646.
183 Chowdhury AH, Cox EF, Francis ST, Lobo DN. A randomized, controlled, double-blind crossover study on the effects of 2-l infusions of 0·9% saline and Plasma-Lyte® 148 on renal blood flow velocity and renal cortical tissue perfusion in healthy volunteers. *Ann Surg* 2012; **256**: 18–24.
184 Shaw AD, Bagshaw SM, Goldstein SL, Scherer LA, Duan M, Schermer CR *et al.* Major complications, mortality, and resource utilization after open abdominal surgery: 0·9% saline compared to Plasma-Lyte. *Ann Surg* 2012; **255**: 821–829.
185 McCluskey SA, Karkouti K, Wijeysundera D, Minkovich L, Tait G, Beattie WS. Hyperchloremia after noncardiac surgery is independently associated with increased morbidity and mortality: a propensity-matched cohort study. *Anesth Analg* 2013; **117**: 412–421.
186 Lobo DN, Stanga Z, Aloysius MM, Wicks C, Nunes QM, Ingram KL *et al.* Effect of volume loading with 1 liter intravenous infusions of 0·9% saline, 4% succinylated gelatine (Gelofusine) and 6% hydroxyethyl starch (Voluven) on blood volume and endocrine responses: a randomized, three-way crossover study in healthy volunteers. *Crit Care Med* 2010; **38**: 464–470.
187 Senagore AJ, Emery T, Luchtefeld M, Kim D, Dujovny N, Hoedema R. Fluid management for laparoscopic colectomy: a prospective, randomized assessment of goal-directed administration of balanced salt solution or hetastarch coupled with an enhanced recovery program. *Dis Colon Rectum* 2009; **52**: 1935–1940.
188 McPhail MJ, Abu-Hilal M, Johnson CD. A meta-analysis comparing suprapubic and transurethral catheterization for

bladder drainage after abdominal surgery. *Br J Surg* 2006; **93**: 1038–1044.
189 Zaouter C, Kaneva P, Carli F. Less urinary tract infection by earlier removal of bladder catheter in surgical patients receiving thoracic epidural analgesia. *Reg Anesth Pain Med* 2009; **34**: 542–548.
190 Basse L, Madsen JL, Kehlet H. Normal gastrointestinal transit after colonic resection using epidural analgesia, enforced oral nutrition and laxative. *Br J Surg* 2001; **88**: 1498–1500.
191 Zingg U, Miskovic D, Pasternak I, Meyer P, Hamel CT, Metzger U. Effect of bisacodyl on postoperative bowel motility in elective colorectal surgery: a prospective, randomized trial. *Int J Colorectal Dis* 2008; **23**: 1175–1183.
192 Noble EJ, Harris R, Hosie KB, Thomas S, Lewis SJ. Gum chewing reduces postoperative ileus? A systematic review and meta-analysis. *Int J Surg* 2009; **7**: 100–105.
193 Lim P, Morris OJ, Nolan G, Moore S, Draganic B, Smith SR. Sham feeding with chewing gum after elective colorectal resectional surgery: a randomized clinical trial. *Ann Surg* 2013; **257**: 1016–1024.
194 Zaghiyan K, Felder S, Ovsepyan G, Murrell Z, Sokol T, Moore B *et al.* A prospective randomized controlled trial of sugared chewing gum on gastrointestinal recovery after major colorectal surgery in patients managed with early enteral feeding. *Dis Colon Rectum* 2013; **56**: 328–335.
195 Convertino VA. Cardiovascular consequences of bed rest: effect on maximal oxygen uptake. *Med Sci Sports Exerc* 1997; **29**: 191–196.
196 Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. *Am J Surg* 2002; **183**: 630–641.
197 Lassen K, Hϕye A, Myrmel T. Randomised trials in surgery: the burden of evidence. *Rev Recent Clin Trials* 2012; **7**: 244–248.
198 Dorcaratto D, Grande L, Pera M. Enhanced recovery in gastrointestinal surgery: upper gastrointestinal surgery. *Dig Surg* 2013; **30**: 70–78.

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