Asian Journal of Surgery (2018) xx, 1–8

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-asianjournalsurgery.com

REVIEW ARTICLE

# Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017)

**Weidong Jia*, Wenbin Liu, Xiaofei Qiao**

*Department of Hepatic Surgery, Anhui Provincial Hospital, The First Affiliated Hospital of University of Science and Technology of China, Anhui Province Key Laboratory of Hepatopancreatobiliary Surgery, Hefei 230001, People's Republic of China*

Received 12 November 2017; received in revised form 22 January 2018; accepted 31 January 2018

**KEYWORDS**
Hepatectomy;
Enhanced recovery after surgery;
Consensus

**Summary** Enhanced recovery after surgery (ERAS) is a series of perioperative optimized treatment measures based on evidence-based medicine which can control perioperative pathological and physiological responses, reduce surgical trauma and postoperative stress, and then achieve rapid recovery. This is a new concept in the 21st century, which is a revolution to the medical treatment and rehabilitation mode. Based on the clinical application study and expert experience in present ERAS in hepatectomy field at home and abroad, Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017) is established. The Chinese Expert consensus is the first guideline in the area of ERAS in hepatic surgery in China, which is drafted by the committee organized by Chinese Medical Association and China International Exchange and Promotive Association for Medical and Health Care.


## 1. Introduction

Enhanced recovery after surgery (ERAS) is a series of perioperative optimized treatment measures based on evidence-based medicine, which can control perioperative pathological and physiological responses, reduce surgical trauma and postoperative stress, realize the targets of postoperative sufficient analgesia and early mobilization, and promote the recovery of organ function, so as to reduce the postoperative complications, promote patients' recovery, shorten the length of hospital stays and save medical cost.[1,2] So far, corresponding guidelines for ERAS after elective colonic surgery, elective rectal/pelvic surgery, pancreaticoduodenectomy and gastrectomy in common surgical fields have been internationally established in succession.[3–6] In domestic, Chinese Expert Consensus on ERAS for Colorectal Surgery (Version 2015), Expert Consensus on ERAS after Hepatopancreatobiliary Surgery

* Corresponding author. Department of Hepatic Surgery, Anhui Provincial Hospital, The First Affiliated Hospital of University of Science and Technology of China, Anhui Province Key Laboratory of Hepatopancreatobiliary Surgery, Number 17 Lujiang Road, Hefei 230001, People's Republic of China.
*E-mail address:* jwd1968@sina.com (W. Jia).

https://doi.org/10.1016/j.asjsur.2018.01.007


Please cite this article in press as: Jia W, et al., Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017), Asian Journal of Surgery (2018), https://doi.org/10.1016/j.asjsur.2018.01.007

(Version 2015), and Chinese Expert Consensus on ERAS Perioperative Management (Version 2016) have also been published.[7–9]

Literatures on ERAS for hepatectomy have been rarely reported at home and abroad, and only preliminary clinical practice and experience can be referenced[10]. In September, 2016, ERAS guidelines for hepatectomy was published by European ERAS Society.[11] However, the clinical strategies recommended by present guidelines are based on the therapeutic protocols of ERAS in colonic surgery, which do not emphasize the influence of basic liver diseases like liver cirrhosis on ERAS. In view of the complexity and characteristics of hepatectomy itself, such as various basic liver diseases, different liver cirrhosis severity, distinguished liver reservation function, and diverse surgical methods and ranges, it cannot be generalized in all patents undergone hepatectomy.[12] For example, if only the key techniques applied in colorectal surgery are followed for all patients, it may not obtain the satisfactory effect of enhanced recovery, or even triggers damage to patients on the contrary.[12] Based on the clinical application study and expert experience in present ERAS in hepatectomy field at home and abroad, Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017) is established. According to the grading of recommendations assessment, development and evaluation (GRADE) system, the level of evidence quality is classified into "high, moderate, low and very low", and the grade of recommendation into "high and general".[13]

## 2. Preoperative items

### 2.1. Preoperative evaluation of liver reservation function

Preoperative accurate evaluation of liver reservation function is of great significance in selecting reasonable therapeutic methods, grasping proper surgical range for hepatectomy, and reducing the incidence rate of postoperative liver failure, and is also the footstone for post-hepatectomy ERAS.[12] The ranges of liver parenchyma lesions, liver function Child-Pugh classification and indocyanine green retention rate within 15 min (ICGR15) classification are used to evaluate patients' liver reservation function, so as to definite the minimum functional liver size that can maintain physiological compensation of human body, in which essential functional liver volume (EFLV) is an important content for the quantitative evaluation of liver reservation function.[14]

#### 2.1.1. Recommendation 1

The patients should receive accurate evaluation of liver reservation function before the surgery (level of evidence: moderate; grade of recommendation: high).

### 2.2. Surgical plan

Three dimension (3D) visualization technology can be used to determine the resectable range of liver, surgical method, surgical approach and optimal liver parenchyma segmentation layer based on the local status of lesions and the relationship with primary adjacent vessels, analysis of size in portal vein perfusion area, and the quantitative evaluation of liver vein drainage area, so as to predict and design the resection and re-construction of important vascular structures and systematically evaluate the surgical risks and establish strategies for risk control, after which different surgical protocols can be compared, screened and optimized based on subjunctive hepatectomy.[15] The therapeutic protocols can be perfected through reasonable surgical decision, controllable surgical interventions and predictable therapeutic efficacy, so as to accelerate postoperative recovery of the patients.[16]

#### 2.2.1. Recommendation 2

3D visualization technology can be applied before the surgery for surgical plan (level of evidence: low; grade of recommendation: general).

### 2.3. Preoperative counseling and education

Preoperative positive psychological counseling is of important significance in reducing perioperative stress and promote postoperative recovery. Counseling and education related to hepatectomy protocols, selection of anesthesia, pain control and respiratory function training will be given orally or in written form by physicians and nurses to patients and their families before the surgery, which will be beneficial to the promotion of early food intake and early mobilization, and help patients and their families cooperate with postoperative recovery and finish ERAS items successfully.[17–20]

#### 2.3.1. Recommendation 3

Patients should receive routine dedicated preoperative counseling and education before hepatectomy (level of evidence: moderate; grade of recommendation: high).

### 2.4. Preoperative nutrition support

Nutritional risk screening (NRS) 2002 is used to screen the nutrition risk in all patients. Patients with nutrition risks will further receive specific nutritional status evaluation devices for nutrient evaluation like patient-generated subjective global assessment (PG-SGA) and subjective global assessment (SGA) in order to figure out their nutritional status. NRS 2002 $\geq$ 3 points indicate the nutrition risk, and nutrition support should be given before the surgery. Patients with NRS 2002 $<$ 3 points will not receive nutrition support temporarily, but should be reevaluated after 1 week or after the surgery and when the disease changes. As to patients with mild and moderate malnutrition, scheduled surgery can be given during nutritional education and treatment. As to patients with severe malnutrition [weight loss $\geq$10–15% within 6 months, food intake $<$ 60% of the recommended nutrient intake, persisting for more than 10d; the body mass index (BMI) $<$ 18.5 kg/m$^2$ and serum albumin (ALB) $<$30 g/L; no hepatorenal dysfunction], nutrition support can be performed for 7–14 d under the guidance of dietitians, and surgery will be conducted after their nutritional status is recovered.[21] Oral immunonutrition is limited in its evidence of therapeutic value in hepatectomy.[11]

Please cite this article in press as: Jia W, et al., Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017), Asian Journal of Surgery (2018), https://doi.org/10.1016/j.asjsur.2018.01.007

#### 2.4.1. Recommendation 4
Patients with nutrition risk should receive nutrition support treatment before hepatectomy, and oral nutritional supplements (ONS) is the first choice (level of evidence: moderate; grade of recommendation: high).

### 2.5. Preoperative bowel preparation

Hepatectomy has relatively low requirements to bowel, and routine preoperative bowel preparation is not recommended as it is not beneficial to patients' homeostasis and postoperative recovery.[22–24]

#### 2.5.1. Recommendation 5
Routine preoperative bowel preparation is not recommended (level of evidence: high; grade of recommendation: high).

### 2.6. Preoperative fasting and water deprivation

Long-term fasting before the surgery is harmful to patients, especially to those complicated with basic liver diseases. Intake of small amount of carbohydrates late at night helps improve the protein metabolism of patients with liver cirrhosis.[25] In addition, intake of high carbohydrates 2 h before induction of anesthesia can relieve patients' anxiety and sense of huger, and reduce postoperative insulin resistance and loss of nitrogen and protein.[3,5]

#### 2.6.1. Recommendation 6
As to patients without gastrointestinal dyskinesis, intake of clear liquid is recommended until preoperative 2–3 h, and solid food is forbidden since preoperative 6 h (level of evidence: low; grade of recommendation: high).

### 2.7. Preoperative application of anti-anxiety medication

Preoperative application of anti-anxiety medication mainly aims to control stress and alleviate anxiety. However, preoperative routine application of long-acting analgesics does not show clinical benefit. Therefore, preoperative routine application of long-acting analgesics is not recommended in ERAS protocols in multiple fields, while short-acting analgesics can be considered in epidural anesthesia. The application of anti-anxiety medication before hepatectomy is not recommended in Meta-analysis.[23–25]

#### 2.7.1. Recommendation 7
Application of long-acting anti-anxiety agents should be avoided before hepatectomy (level of evidence: moderate; grade of recommendation: high).

### 2.8. Preventive application of antibacterial agents[26]

It is proposed that antibacterial agents be applied 30 min-1 h before skin incision or at begin of anesthesia, for which intravenous administration is recommended. Surgery begins after the end of infusion to ensure that the antibacterial agents in local tissues exposed in surgical site have reached a concentration enough to kill the infected bacteria during operation. The effective acting time of antibacterial agents should run through all surgery procedures, and the agents should be used additionally during operation if the surgical duration is >3 h or exceeds >2 folds of the half-life period of all agents, or the hemorrhagic volume is more than 1500 mL in adults. The time of preventive drug administration should be less than 24 h. The possible infected bacteria in hepatectomy include Gram-negative bacilli and anaerobic bacteria (such as bacteroides fragilis), for which the optional antibacterial agents include the first and second generations of cephalosporins or ceftriaxone and (or) metronidazole, or cephamycins. The first generation of cephalosporins with evidence of evidence-based medicine is cefazolin while the second generation is cefuroxime. If patients are allergic to β-lactams, clindamycin + aminoglycosides or aminoglycosides + metronidazole can be applied.

#### 2.8.1. Recommendation 8
Antibacterial agents can be used preventively before hepatectomy (level of evidence: moderate; grade of recommendation: high).

## 3. Intra-operative items

### 3.1. Selection of anesthesia

The anesthesia mode for hepatectomy should be selected based on surgical types, patients' disease conditions and liver function, including general anesthesia, epidural anesthesia, and general anesthesia combined with epidural anesthesia.[17,27] Laparoscopic hepatectomy usually adopts general anesthesia with endotracheal intubation, or general anesthesia combined with epidural anesthesia.[28] If patients are free from coagulation dysfunction, epidural anesthesia through middle thorax is an ideal anesthetic selection for laparotomy hepatectomy as it is in favor of protecting lung function, relieving cardiovascular load, reducing postoperative paralytic ileus and stress response, and shorten the length of hospital stays.[29–31]

#### 3.1.1. Recommendation 9
Epidural anesthesia through middle thorax can be discretionarily considered according to patients' disease conditions (level of evidence: moderate; grade of recommendation: high).

### 3.2. Surgical methods

The surgical methods can be divided into laparotomy hepatectomy, laparoscopic hepatectomy and robot-assisted laparoscopic hepatectomy based on abdominal approaches for surgical methods, and into anatomical hepatectomy and non-anatomical hepatectomy based on surgical methods. Surgical approaches and incision should be selected to excellently expose surgical field. It is advised that ultrasound should be used in operation to explore the number and range of liver lesions, diagnose the anatomical relationship between lesions in liver parenchyma and important vascular structure, and mark the running direction of important

Please cite this article in press as: Jia W, et al., Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017), Asian Journal of Surgery (2018), https://doi.org/10.1016/j.asjsur.2018.01.007

vessels such as liver veins. Application of methods like staining with methylene blue or selective blockage of hepatic blood flow that requires resection of liver segment contributes to the accurate demarcate the boarder of liver segment. Laparoscopic hepatectomy can be conducted by experienced hepatobiliary surgeons, especially resection of left exterior liver lobe and resection of anterior liver lesions

#### 3.2.1. Recommendation 10
Laparoscopic hepatectomy can be conducted by experienced hepatobiliary surgeons (level of evidence: moderate; grade of recommendation: high).

### 3.3. Control of liver blood flow

Application of techniques to control liver blood flow in hepatectomy conduces to reducing hemorrhagic volume, protecting organ function and resecting lesions safely. Individual technique for control of liver blood flow is advocated.[32] As to patients with serious damage of liver parenchyma and reserved liver function size located in borderline state, methods that do not block liver blood flow or elective blockage of half-liver blood flow can be considered. As to patients with normal liver parenchyma and enough reserved liver function size, Pringle and intermittent blockage method (blood flow of porta hepatis is blocked for 15 min and then opened for 5 min intermittently) can be selected. During operation, central venous pressure (CVP) should be controlled cautiously so as to ensure that CVP s CVP$<$5 cm$H_2O$ (1 cm$H_2O$ $=$ 0.098 kPa).

#### 3.3.1. Recommendation 11
Individual technique for control of liver blood flow is advocated (level of evidence: low; grade of recommendation: high).

### 3.4. Separation of liver parenchyma

The methods for separation of liver parenchyma is selected according to the zonal distribution characteristic of liver vessels, in which cut-ultrasound aspiration and ultrasound knife are used for the accurate anatomy of central liver or zone near to liver vessels, while forceps holder combined with electrocoagulation is applied in peripheral liver zone without important vascular structure.[16] Application of refined instrument for separation of liver parenchyma can accurately anatomize and treat the vascular structures on liver cross section, maintain the integrity of vascular structure of the residual liver tissues, and avoid the approximating suture to liver cross section. The optimal selection of techniques for separation of liver parenchyma can reduce the intra-operative hemorrhagic volume to the minimum, decrease the incidence of postoperative hemorrhage on liver cross section and postoperative biliary fistula, protect the function of residual liver, reduce the incidence of postoperative liver failure, and enhance patients' postoperative early recovery.[12]

#### 3.4.1. Recommendation 12
Refined techniques for separation of liver parenchyma are recommended, and routine approximating suture to liver cross section is not advocated (level of evidence: low; grade of recommendation: general).

### 3.5. Indwelling of nasogastric tubes

Indwelling of nasogastric tubes may induce postoperative discomfort and stress response, induce or aggravate pulmonary infection and pulmonary atelectasis, impact postoperative early food intake, and postpone the post-hepatectomy recovery.[33] The indwelled nasogastric tube in hepatectomy should be withdrawn at the end of the surgery. Routine application of nasogastric tubes to reduce pressure is not recommended after the surgery.

#### 3.5.1. Recommendation 13
Indwelling of nasogastric tubes is not recommended to be used routinely as it may increase the risk of pulmonary complications after hepatectomy (level of evidence: high; grade of recommendation: high).

### 3.6. Preventing intra-operative hypothermia

Occurrence of intra-operative hypothermia ($<$36 °C) is related with the function of anesthetics in inhibiting the body's temperature regulating effect and the loss of intra-operative heat, which may induce abnormal coagulation function, increase of cardiovascular events, and increase of postoperative infection, etc. Application of comprehensive insulation measures in hepatectomy, such as preheating insulation mattress in advance, covering inflatable insulation blanket on non-surgery zone, warming abdominal washing fluid, and using infusion warmer to warm the infused fluid, etc. can prevent the occurrence of intra-operative hypothermia, reduce the occurrence of post-operative complications, and enhance patients' post-operative recovery.[30]

#### 3.6.1. Recommendation 14
Normothermia should be maintained during the hypothermia. (level of evidence: moderate; grade of recommendation: high).

### 3.7. Indwelling of abdominal drainage tubes

Indwelling of abdominal drainage tubes during the hypothermia aims to drainage abdominal effusion to relieve intra-abdominal pressure, observe postoperative abdominal hemorrhage and early discover the biliary fistula.[34] However, the indwelling of drainage tubes cannot reduce the incidence of postoperative complications.[35] No indwelling of abdominal drainage tube can enhance patients' post-operative recovery, and the tube may be unnecessary as the incidence of postoperative complications significantly decreases with the update of hepatectomy techniques.[36,37] It is advised that abdominal drainage tubes should be indwelled according to specific disease conditions.[27,33,38]

#### 3.7.1. Recommendation 15
Routine indwelling of abdominal drainage tubes in hepatectomy is not advocated (level of evidence: low; grade of recommendation: general).

Please cite this article in press as: Jia W, et al., Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017), Asian Journal of Surgery (2018), https://doi.org/10.1016/j.asjsur.2018.01.007

## 4. Postoperative items

### 4.1. Prophylactic and multimodal analgesia

Post-hepatectomy pain is complicated in influencing factors. About half of the patients will experience moderate and severe pain after surgery using traditional pain management model, which severely impacts their postoperative enhanced recovery.[39] In principle, prophylactic and multimodal analgesia should be applied for postoperative analgesia.[40] Prophylactic analgesia mainly prevents central and peripheral sensitization through pre-, intra- and postoperative pain management, so as to reduce the postoperative pain severity and the use dosage of Opioids. Multimodal analgesia is a method that combines analgesic methods or analgesics with different action mechanisms, which leads to synergy or addition of analgesic effects. Meanwhile, the dosage of each agent used decreases, with adverse reactions decease accordingly, which achieve the maximum ratio of analgesic efficacy and adverse reaction. Multimodal analgesic methods include the retardation of posterior sheath of rectus abdominis and (or) transversus abdominis plane (TAP), patient control analgesia (PCA), and local infiltration of incision, etc.

Application of Opioids for postoperative analgesia can inhibit postoperative intestinal function, and may also bring about various adverse reactions, thus influencing patients' postoperative recovery. However, application of nonsteroidal anti-inflammatory drugs (NSAIDs) has certain analgesic efficacy after the surgery and can also reduce the use dosage of Opioids. NSAIDs can be divided into nonselective NSAIDs and selective cyclooxygenase-2 (COX-2) inhibitors. Traditional nonselective NSAIDs are not recommended for postoperative analgesia as they may increase the risk of hemorrhage and the incidence rate of stress ulcer.[41,42] Preoperative application of selective COX-2 inhibitors has certain prophylactic analgesic efficacy and can reduce postoperative pain.[43] Although epidural analgesia has been recommended to the basic strategy of ERAS for colorectal surgery, its postoperative application is still controversial internationally at present in light of the possible coagulation dysfunction after hepatectomy.[44,45] Regional retardation is advisable for post-hepatectomy analgesia because it is excellent in analgesic efficacy, and is beneficial to the postoperative early mobilization and recovery.

#### 4.1.1. Recommendation 16

Prophylactic and multimodal analgesia should be used in hepatectomy at perioperative period (level of evidence: moderate; grade of recommendation: high).

### 4.2. Perioperative anti-thrombotic treatment

Patients with hepatectomy are usually complicated with chronic hepatic diseases and obstructive jaundice, etc. and occasionally accompanied by thrombocytopenia and platelet function defect besides deficiency of coagulation factors. They often suffer from coagulation dysfunction before operation, and may have intra- and postoperative abnormal coagulation function, especially the hemodynamic change induced by large-area liver resection and blockage of liver blood flow, due to long-term anesthetic duration, large surgical trauma, profuse intraoperative hemorrhage, and massive and quick infusion, etc.[46] Perioperative anti-thrombotic treatment measures contain basic prevention, mechanical prevention and medicine prevention. The basic prevention means early mobilization, while mechanical prevention is the intermittent pneumatic compression (IPC), and medicine prevention include common heparin, low molecular weight heparin (LMWH), and Aspirin, etc. The primary barrier against the preventive anti-thrombotic treatment using medicine after hepatectomy is the concern of postoperative hemorrhage. A retrospective study has revealed that preventive anti-thrombotic treatment using medicine does not increase the rate of postoperative hemorrhage.[47] At present, whether preventive anti-thrombotic treatment using medicine should be applied in ERAS for hepatectomy is still controversial.[20,22,48]

#### 4.2.1. Recommendation 17

Combing with the internal clinical practice at present, routine application of preventive anti-thrombotic treatment using medicine in peri-hepatectomy is not recommended in this consensus (level of evidence: low; grade of recommendation: general recommendation).

### 4.3. Prevention of postoperative nausea and vomiting (PONV)

PONV influences postoperative early food intake, and is one of the causes for delayed discharge, and preventing PONV is an important part of ERAS. The risk factors of PONV include females, history of PONV or motion sickness, non-smokers, postoperative application of Opioids, application of anesthetics for inhalation, adults $<$50 years old, and laparoscopic surgery, etc. As to patients with PONV risk receiving hepatectomy, it is advised that antiemetic drugs should be used preventively, in which drugs with different action mechanism are recommended to be used in combination, such as 5-HT3 receptor antagonists, and glucocorticoids, etc.

#### 4.3.1. Recommendation 18

Multimodal PONV preventive methods are recommended (level of evidence: moderate; grade of recommendation: high).

### 4.4. Perioperative fluid treatment

Patients suffer from imbalance of water and electrolytes in the early stage after hepatectomy, and liver dysfunction further influences the balance of water and electrolytes. Therefore, perioperative fluid treatment is associated with the intra-operative safety and postoperative recovery of patients with hepatectomy directly.[49] Excessive fluid infusion will increase circular capacity and heart load, thus leading to intestinal tract edema and increasing the volume of body fluid in pulmonary mesenchyme, and it is also a risk factor for the postoperative pleural effusion and abdominal effusion. If there is no evidence of insufficient blood

Please cite this article in press as: Jia W, et al., Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017), Asian Journal of Surgery (2018), https://doi.org/10.1016/j.asjsur.2018.01.007

volume, hypotension induced by intra-operative anesthesia and postoperative epidural analgesia should be treated with pressor agents. It is advised to conduct perioperative goal-oriented fluid treatment based on indexes for monitoring of capacity in order to maintain effective circular blood volume, ensure micro-circular perfusion and oxygen supply to tissues, and avoid infusion of excessive fluid.[50]

#### 4.4.1. Recommendation 19

Perioperative goal-oriented fluid management should be conducted based on the indexes for monitoring of capacity (level of evidence: moderate; grade of recommendation: strong recommendation).

### 4.5. Regulation and control of excessive inflammatory and stress responses

Multiple injury factors in hepatectomy, such as surgical trauma, blood infusion, anesthesia, pain, infection and anxiety, etc. can induce the excessive release of proinflammatory factors and induce local and general inflammatory responses. They are important causes for various complications, and may threaten patients' lives in severe condition. Reasonable perioperative evaluation, monitoring and treatment as well as application of a series of optimization measures in the whole surgical process may reduce the general, local and psychological, etc. traumatic stress caused by hepatectomy, and control the excessive inflammatory responses and their adverse outcomes, consequently protecting the function of important organs and enhancing patients' postoperative recovery.[51] H2 receptor antagonists and proton pump inhibitors can effectively prevent stress mucosal lesions, and reduce the postoperative upper gastrointestinal hemorrhage and hemorrhage-induced risks.

#### 4.5.1. Recommendation 20

As to patients with basic diseases like liver cirrhosis and large surgical trauma, reasonable application of hormones, various anti-inflammatory agents, H2 receptor antagonists or proton pump inhibitors, etc. are recommended to regulate and control excessive inflammatory and stress responses after hepatectomy (level of evidence: moderate; grade of recommendation: high).

### 4.6. Prevention and treatment of postoperative abdominal effusion

Patients with hepatocellular carcinoma (HCC) are often complicated with different-degree liver cirrhosis and portal hypertension (PHT). Profuse abdominal effusion after hepatectomy not only induces loss of plasma proteins, electrolyte disorder, and inhibition of liver regeneration, but also leads to risks of spontaneous peritonitis and hepatorenal syndrome. There are numerous methods acceptable for the prevention and treatment of abdominal effusion, including controllable fluid infusion, infusion of protein to increase colloid osmotic pressure, application of small-dose diuretics, and use of terlipressin.[52]

#### 4.6.1. Recommendation 21

As to patients with basic diseases like liver cirrhosis and portal hypertension, reasonable application of multiple methods after hepatectomy is recommended to prevent and treat abdominal effusion (level of evidence: moderate; grade of recommendation: high).

### 4.7. Early withdrawal of urethral catheters and abdominal drainage tubes

It is advised that the urethral catheters should be withdrawn within postoperative 1—2 d because indwelling of urethral catheters can increase the risk of urinary system, aggravate patients' discomfort and influence postoperative early mobilization. If drainage tubes are indwelled, they should be withdrawn as early as possible if there is no obvious drainage fluid within postoperative 1—2 d and no obstruction of drainage observed.

#### 4.7.1. Recommendation 22

Postoperative early withdrawal of urethral catheters and abdominal drainage tubes is recommended (level of evidence: moderate; grade of recommendation: high).

### 4.8. Postoperative early food intake

Early food intake after hepatectomy can promote the recovery of gastrointestinal function, supplement nutrition safely and effectively, correct the electrolyte disorder and balance of negative nitrogen, and have important promotion effect to postoperative enhanced recovery. The patients should be encouraged to drink water within postoperative 4—6 h, and take liquid or semi-liquid diet on postoperative d1 which will be transferred to normal diet gradually. As to patients with nutrient risk and malnutrition, nutritional support treatment should be given prepensely, for whom ONS is the first choice.

#### 4.8.1. Recommendation 23

Postoperative early normal diet is recommended, and postoperative enteral nutrition or parenteral nutrition is only limited to the patients with malnutrition (level of evidence: moderate; grade of recommendation: high).

### 4.9. Postoperative early mobilization

Postoperative early mobilization can promote the recovery of gastrointestinal function, reduce the occurrence of pulmonary complications and prevent the formation of deep vein thrombus, and sufficient analgesia is premise for postoperative early off-bed activities. ERAS study has demonstrated that only 20—28% patients have off-bed activities on d1 post-hepatectomy,[18,29] and 85% on d3.[16] Therefore, establishment of target of daily activities after hepatectomy is necessary, with activity level increased day by day.[49]

#### 4.9.1. Recommendation 24

The Target of daily activities after surgery should be established, and patients should be encouraged to take

early activities after surgery (level of evidence: low; grade of recommendation: general).

## 5. Establishment of discharge standards for discharge from the hospital

The recommended discharge standards[17,53] for ERAS for hepatectomy: Patients have basic self-care ability in life; patients have pain relieved or pain controlled favorably by oral analgesics; patients have normal food intake without need of intravenous fluid infusion; patients have smooth defecation and aerofluxus; patients have liver function Child-Pugh classification in class A or have bilirubin recovered to normal or near to normal; patients have excellently healed wound without infection (no need to wait for suture withdrawal); and patients agree to and wish to be discharged from the hospital.

## 6. Conclusion

In view of the complexity of hepatectomy, such as various basic liver diseases, different liver cirrhosis severity, distinguished liver reservation function, and diverse surgical methods and ranges, it cannot be generalized in all patents undergone/performed hepatectomy. The clinical application of present consensus on ERAS should be combined with individualized perioperative treatment. In addition, the clinical application of the consensus is a step-by-step process instead of an overnight process, and it still needs to be combined with the specific clinical practice of discipline following the principle of "safety preferred and efficacy concurred".

Compared with the traditional perioperative treatment, ERAS strategies used in perioperative period has reduced the incidence of common complications after hepatectomy significantly except the incidence of hepatectomy-specific complications like hemorrhage, biliary fistula and liver failure, etc. Preoperative subjective evaluation of liver function state, reasonable design of liver resection method, and accurate surgical operation are the key measures for reducing the incidence of surgical complications, and ERAS clinical strategies cannot replace the accurate surgical operation.

Although present studies have indicated that ERAS applied in hepatectomy has certain safety, feasibility and validity, there are still numerous issues to be resolved, and partial clinical strategies is lack of evidence-based medical study. More importantly, the basic liver diseases have not been concerned emphatically, especially the influence of hepatitis B liver cirrhosis on ERAS. The present consensus may be further perfected by virtue of focusing on the basic liver diseases and their characteristics, and will be conducting multicenter clinical studies positively under the guidance of evidence-based medicine through the joint effort of multidisciplinary groups.

## Conflicts of interest

All authors have no conflicts of interest regarding this paper.

## Acknowledgments

This research was supported by the Key Programs for Research and Development of Anhui Province in 2017(No.1704a0802150).

## References

1. Wilmore DW. Therapy which enhances surgical recovery: the potential for multimodality, fast-track surgery in the 21st century. *Nihon Geka Gakkai Zassh*. 2000;101:281–283.
2. Wilmore DW, Kehlet H. Management of patients in fast track surgery. *BMJ*. 2001;322:473–476.
3. Gustafsson UO, Scott MJ, Schwenk W, et al. Guidelines for perioperative care in elective colonic surgery: enhanced recovery after surgery (ERAS®) society recommendations. *Clin Nutr*. 2012;31:783–800.
4. Nygren J, Thacker J, Carli F, 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. Lassen K, Coolsen MM, Slim K, et al. Guidelines for perioperative care for pancreaticoduodenectomy: enhanced recovery after surgery (ERAS®) society recommendations. *Clin Nutr*. 2012;31:817–830.
6. Mortensen K, Nilsson M, Slim K, et al. Consensus guidelines for enhanced recovery after gastrectomy: enhanced recovery after surgery (ERAS® ) society recommendations. *Br J Surg*. 2014;101:1209–1229.
7. China ERAS, Group of CSPEN (Chinese Society of Parenteral and Enteral Nutrition). Chinese consensus of enhanced recovery after surgery for colorectal surgery (2015 edition). *Chin J Dig Surg*. 2015;14:606–608 [In Chinese, English abstract].
8. Chinese Research Hospital Association, Society for Hepatopancreatobiliary Surgery. Expert consensus on enhanced recovery after hepatopancreatobiliary surgery(2015 edition). *Chin J Dig Surg*. 2016;15:1–6 [In Chinese].
9. Chinese expert group on enhanced recovery after surgery. Chinese expert consensus on perioperative management of enhanced recovery after surgery (2016). *Chin J Surg*. 2016;54:413–418 [In Chinese].
10. Luo Pengfei, Jia Weidong, Xu Geliang, et al. Clinical Pathway of enhanced recovery after surgery in patients undergoing hepatectomy for primary liver cancer. *Chin J Gen Surg*. 2015;30:862–865 [In Chinese, English abstract].
11. Melloul E, Hübner M, Scott M, et al. Guidelines for perioperative care for liver surgery: enhanced recovery after surgery (ERAS) society recommendations. *World J Surg*. 2016;40:2425–2440.
12. Jia Weidong, Luo Pengfei. Application of enhanced recovery after surgery in the preeision liver Surger. *Chin J Dig Surg*. 2015;14:25–28 [In Chinese, English abstract].
13. Andrews JC, Schünemann HJ, Oxman AD, et al. GRADE guidelines: 15. going from evidence to recommendation-determinants of a recommendation's direction and strength. *J Clin Epidemiol*. 2013;66:726–735.
14. Liang Chen, Guoying Wang, Yangyang. Research progress of staged hepatectomy combined with hepatic disconnection and portal vein ligation. *Chin J Hepat Surg (Electronic Edition)*. 2017;6:71–74 [In Chinese].
15. Ma Jin, Geng Xiaoping. Application of three dimensional visualization technique in preoperative planning of complex primary liver cancer. *Chin J Hepat Surg (Electronic Edition)*. 2016;5:72–76 [In Chinese, English abstract].
16. Jia-hong Dong, Mao-sheng Tang, Wen-zhi Zhang, et al. Effects of concept and techniques of precision liver surgery on the

perioperative safety of patients undergoing major hepatectomy. *Chin J Dig Surg*. 2013;12:344–351 [In Chinese, English abstract].
17. van Dam RM, Hendry PO, Coolsen MM, et al. Initial experience with a multimodal enhanced recovery programme in patients undergoing liver resection. *Br J Surg*. 2008;95:969–975.
18. Stoot JH, van Dam RM, Busch OR, et al. The effect of a multimodal fast-track programme on outcomes in laparoscopic liver surgery: amulticentre pilot study. *HPB*. 2009;11:140–144.
19. Hendry PO, van Dam RM, Bukkems SF, et al. Randomized clinical trial of laxatives and oral nutritional supplements within an enhanced recovery after surgery protocol following liver resection. *Br J Surg*. 2010;97:1198–1206.
20. Lin DX, Li X, Ye QW, Lin F, Li LL, Zhang QY. Implementation of a fast-track clinical pathway decreases postoperative length of stay and hospital charges for liver resection. *Cell Biochem Biophys*. 2011;61:413–419.
21. Chinese Society of Parenteral and Enteral Nutrition. Guidelines for nutritional support in adults during perioperative period. *Chin J Surg*. 2016;54:641–657 [In Chinese].
22. Coolsen MM, Wong-Lun-Hing EM, van Dam RM, et al. A systematic review of outcomes in patients undergoing liver surgery in an enhanced recovery after surgery pathways. *HPB*. 2013;15:245–251.
23. Hughes MJ, McNally S, Wigmore SJ. Enhanced recovery following liver surgery: a systematic review and meta-analysis. *HPB*. 2014;16:699–706.
24. Lei Q, Wang X, Tan S, Xia X, Zheng H, Wu C. Fast-track programs versus traditional care in hepatectomy:a meta-analysis of randomized controlled trials. *Dig Surg*. 2014;31:392–399.
25. Plauth M, Cabré E, Campillo B, et al. ESPEN guidelines on parenteral nutrition: hepatology. *CLin Nutr*. 2009;28:436–444.
26. People's Republic of China national health and Family Planning Commission. Guidelines for Clinical Application of Antimicrobial Agents(2015 Edition). http://www.nhfpc.gov.cn/yzygj/s3593/201508/c18e1014de6c45ed9f6f9d592b43db42.shtml. [In Chinese].
27. Ni CY, Yang Y, Chang YQ, et al. Fast-track surgery improves postoperative recovery in patients undergoing partial hepatectomy for primary liver cancer: a prospective randomized controlled trial. *Eur J Surg Oncol*. 2013;39:542–547.
28. The Hepatic Surgery Group of Chinese Medical Association. Expert consensus on laparoscopic hepatectomy and guideline for operative procedure(2013 edition). *Chin J Dig Surg*. 2013;12:161–165 [In Chinese, English abstract].
29. Koea JB, Young Y, Gunn K. Fast track liver resection: the effect of a comprehensive care package and analgesia with single dose intrathecal morphine with gabapentin or continuous epidural analgesia. *HPB Surg*. 2009;2009:271986.
30. Jones C, Kelliher L, Dickinson M, et al. Randomized clinical trial on enhanced recovery versus standard care following open liver resection. *Br J Surg*. 2013;100:1015–1024.
31. Wong-Lun-Hing EM, van Dam RM, Heijnen LA, et al. Is current perioperative practice in hepatic surgery based on enhanced recovery after surgery (ERAS) principles? *World J Surg*. 2014;38:1127–1140.
32. Zhang Bixiang, Chen Xiaoping. Individualized hepatic blood flow control technique in hepatectomy. *J Clin Surg*. 2012;20:1–4 [In Chinese].
33. Schultz NA, Larsen PN, Klarskov B, et al. Evaluation of a fast-track programme for patients undergoing liver resection. *Br J Surg*. 2013;100:138–143.
34. Bona S, Gavelli A, Huguet C. The role of abdominal drainage after major hepatic resection. *Am J Surg*. 1994;167:593–595.
35. Butte JM, Grendar J, Bathe O, et al. The role of peri-hepatic drain placement in liver surgery: a prospective analysis. *HPB*. 2014;16:936–942.
36. Liu CL, Fan ST, Lo CM, et al. Abdominal drainage after hepatic resection is contraindicated in patients with chronic liver disease. *Ann Surg*. 2004;239:194–201.
37. Sun HC, Qin LX, Lu L, et al. Randomized clinical trial of the effects of abdominal drainage after elective hepatectomy using the crushing clamp method. *Br J Surg*. 2006;93:422–426.
38. Sánchez-Pérez B, Aranda-Narváez JM, Suárez-Muñoz MA, et al. Fast-track program in laparoscopic liver surgery: theory or fact? *World J Gastrointest Surg*. 2012;4:246–250.
39. Luo Pengfei, Jia Weidong, Xu Geliang, et al. Analysis of postoperative pain of hepatectomy. *Chin J Gen Surg*. 2015;30:194–197 [In Chinese, English abstract].
40. Jia Weidong, Qiao Xiaofei. Construction of painless ward in the era of precision liver surgery. *Chin J Dig Surg*. 2014;13:415–418 [In Chinese, English abstract].
41. Mimoz O, Incagnoli P, Josses C, et al. Analgesic efficacy and safety of nefopam vs. propacetamol following hepatic resection. *Anaesthesia*. 2001;56:520–525.
42. Chandok N, Watt KD. Pain management in the cirrhotic patient: the clinical challenge. *Mayo Clin Proc*. 2010;85:451–458.
43. Leng Xisheng, Wei Junmin, Liu Lianxin, et al. Expert consensus on perioperative pain management in general surgery. *Chin J Gen Surg*. 2015;30:166–173 [In Chinese].
44. Revie EJ, Massie LJ, McNally SJ, McKeown DW, Garden OJ, Wigmore SJ. Effectiveness of epidural analgesia following open liver resection. *HPB*. 2011;13:206–211.
45. Tzimas P, Prout J, Papadopoulos G, Mallett SV. Epidural anaesthesia and analgesia for liver resection. *Anaesthesia*. 2013;68:628–635.
46. Editorial Department of Chinese Journal of Surgery. Expert consensus on the evaluation of coagulation function and intervention of coagulation disorders in department of hepatobiliary surgery. *Chin J Surg*. 2012;50:678–683 [In Chinese].
47. Reddy SK, Turley RS, Barbas AS, et al. Post-operative pharmacologic thromboprophylaxis after major hepatectomy: does peripheral venous thromboembolism prevention outweigh bleeding risks? *J Gastrointest Surg*. 2011;15:1602–1610.
48. Takamoto T, Hashimoto T, Inoue K, et al. Applicability of enhanced recovery program foradvanced liver surgery. *World J Surg*. 2014;38:2676–2682.
49. Wrighton LJ, O'Bosky KR, Namm JP, Senthil M. Postoperative management after hepatic resection. *J Gastrointest Oncol*. 2012;3:41–47.
50. Zhao Yupei, Yang Yinmo, Lou Wenhui, et al. Expert consensus on perioperative fluid therapy in surgical patients(2015). *Chin J Pract Surg*. 2015;35:960–966 [In Chinese].
51. Committee of Liver Cancer of Chinese Anti-Cancer Association. Multiple disciplinary consensus on the management of excessive inflammatory response in the perioperative period of hepatectomy(2014 edition). *Chin J Dig Surg*. 2014;13:751–755 [In Chinese, English abstract].
52. Fayed N, Refaat EK, Yassein TE, Alwaraqy M. Effect of perioperative terlipressin infusion on systemic,hepatic, and renal hemodynamics during living donor liver transplantation. *J Crit Care*. 2013;28:775–782.
53. Wong-Lun-Hing EM, Lodewick TM, Stoot JH, et al. A survey in the hepatopancreatobiliary community on ways to enhance patient recovery. *HPB*. 2012;14:818–827.

Please cite this article in press as: Jia W, et al., Chinese Expert Consensus on Enhanced Recovery After Hepatectomy (Version 2017), Asian Journal of Surgery (2018), https://doi.org/10.1016/j.asjsur.2018.01.007