

ORIGINAL ARTICLE

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## Laparoscopic liver resection for malignancy in high-risk surgical patients according to ASA classification

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### Summary

Laparoscopic liver resection (LLR) represents one of the most recent evolutions in the field of surgical oncology. While offering to the patients all the short-term advantages of the laparoscopic approach, the ongoing experience underlines that the long-term outcomes are not negatively influenced through this minimally invasive method. We explored the surgical results in a case series of 5 high-risk patients with American Society of Anesthesiologists' (ASA) Class 3 or more, who underwent LLR in our department. Three biseg-

mentectomies, one segmentectomy and one wedge resection were performed. All patients could be discharged within the first postoperative week. LLR was safe and efficient in this high-risk patient group. Careful patient selection and individualized preparation for surgery remain the keys for the success of LLR in high ASA class patients.

**Key words:** anesthesia, hepatectomy, laparoscopy, liver resection, minimally invasive surgery

### Introduction

Performance of LLR has become more widespread during the last two decades although initially treated with skepticism and restraint. Since the first reports of resections of lesions located in superficial liver segments [1,2], the evolution of laparoscopic instruments and parenchymal transection devices, combined with improved understanding of the vascular anatomy of the liver, have overcome previous limits. Recent literature supports the feasibility and safety of LLRs for high-complexity major resections of malignant cases [3,4] as well as for living donor organ procurement [5]. Moreover, the advantages of LLR over the open procedure are now well documented [6,7]. In general, LLR confers the benefits of other laparoscopic procedures: decreased postoperative pain, early mobilization, reduced blood loss, ear-

lier resumption of normal intestinal function and oral intake and shorter hospital stay. These advantages make LLR an appealing concept for patients with comorbidities.

ASA' physical status class (ASA-PS) is an assessment measure based on the patient's physical status and is defined according to the ASA' relative value guide, which is published each year [8]. Despite its initial introduction as a research tool in 1941 [9] its use was not generally accepted until 1961, when Dripps et al. [10] described a close association with increased surgical mortality. Subsequent studies confirmed association with morbidity and increased incidence of postoperative complications [11] including postoperative Intensive Care Unit outcomes [12]. Consequently, ASA-PS classification has been used worldwide as

**Table 1.** Details of LLRs and outcomes for ASA PS class 3 and 4 patients

Cases	ASA- PS class	Tumor site (segment)	Type of hepatectomy	Histological results	Transfusion requirement (cRBCs)	POD of discharge
Case 1	IV	V-VI	Bisegmentectomy V/VI	pT1 R0	4	7
Case 2	III	VI	Wedge resection VI	pM1 R0	0	5
Case 3	III	II-III	Left lateral hepatectomy	pT2 R0	2	6
Case 4	III	VI	Segmentectomy VI	pT1 R0	0	5
Case 5	III	VI - VII	Bisegmentectomy VI/VII	pT1 R0	0	5

For abbreviations see text

a perioperative assessment tool for more than 60 years. Given the high morbidity/mortality of patients assigned to higher ASA-PS class (class III or IV), minimizing surgical risk through adoption of minimally invasive surgery techniques may have a favorable impact on postoperative outcome.

Of note, despite the wide incorporation of LLR in clinical practice, poor data are available on the feasibility and safety of this procedure in patients with high-risk comorbidities. The aim of this retrospective cohort study was to summarize our clinical experience of LLRs in patients with an ASA-PS class of III or IV at a single center.

## Cases' presentation

Between February 2012 and February 2016, 40 patients have undergone LLR in our department whereas 5 patients were assigned to ASA-PS class III or IV. All procedures were performed under general anesthesia and after obtaining informed consent. Each case is presented in summary and details of LLRs and outcome parameters are summarized in Table 1.

### Case 1

A 71-year-old male patient with cirrhosis due to hepatitis B virus (HBV) infection and to alcoholic liver disease (ALD) was referred to our department with a focal liver lesion diagnosed during his routine ultrasound evaluation. At the time of diagnosis the patient was asymptomatic. Abdominal computer tomography (CT) and magnetic resonance imaging (MRI) confirmed a tumor in segments V-VI of the liver (4.7x4.5x4.3cm) with characteristics suggestive of hepatocellular carcinoma (HCC). The patient had a history of type 2 diabetes mellitus, arterial hypertension, coronary artery disease (CAD) with previous myocardial infarction and echocardiographic findings of both systolic and diastolic left ventricular (LV) dys-

function (LVEF=30%, NYHA=II). He was a previous smoker (40 pack-years) with chronic obstructive pulmonary disease (COPD) classified as CAP B (COPD assessment test). His body mass index (BMI) was 45 kg/m<sup>2</sup> and was classified as morbidly obese patient. The patient was assigned as ASA-PS score IV and underwent laparoscopic resection of segments V-VI. Operative time was 105 min. On postoperative day (POD) 1 the patient developed moderate-grade acute renal failure and impaired hepatic function classified as Grade II according to the Clavien-Dindo classification, both of which returned to normal levels on 6<sup>th</sup> POD and was discharged from hospital on the 7<sup>th</sup> POD. Histology report revealed a moderately differentiated (G2) HCC not presenting vascular or lymphatic invasion (pT1) with negative margins (R0 resection). Twenty-six months later the patient remains disease-free with good functional capacity.

### Case 2

A 76-year-old male patient was admitted to our department for surgical treatment of a single liver metastasis from colorectal cancer. The patient had been operated for rectal adenocarcinoma 18 months ago and due to elevated levels of CEA during his routine follow up he was subjected to an abdominal CT scan, which revealed a 12 mm solitary mass located in segment VI. His further medical history included arterial hypertension, CAD and a stroke 3 years ago. Preoperative neurologic assessment revealed tremor and walking instability. His functional capacity was severely impaired (METS  $\leq$ 4). Due to these comorbidities, he was assessed as an ASA-PS III patient. The patient underwent a laparoscopic wedge resection (segment VI). Operative time was 90 min. His postoperative course was uneventful and he was discharged from hospital on the 5<sup>th</sup> POD. Histology report revealed a liver metastasis with negative margins (R0 resection) compatible with the pa-

tient's previous history of rectal adenocarcinoma. One year later the patient remains disease-free.

#### Case 3

A 65-year-old male patient with a history of ALD cirrhosis and bleeding of esophageal varices was referred to our department for surgical treatment of a focal liver lesion which was identified during his routine ultrasound follow-up. CT revealed two lesions located in segments II-III presenting typical radiologic characteristics of HCC. Regarding his medical history, one month ago the patient was subjected to percutaneous aortic valve replacement, thus he presented for surgery while on dual anti-platelet therapy. The patient was assessed as an ASA-PS class III. Preoperative echocardiography revealed LV hypertrophy with LV diastolic dysfunction type II, but LV systolic function within normal limits (LVEF=60%). He had a history of smoking (60 pack-years) and COPD, classified as CAP B. He underwent a laparoscopic left lateral hepatectomy. Operative time was 120 min. His postoperative course was uneventful and the patient was discharged on the 6<sup>th</sup> POD. Histology report revealed a multifocal low grade (G3) HCC with vascular invasion pT2 and tumor-free resection margins (R0 resection). The patient remains disease-free 9 months after surgery.

#### Case 4

An 81-year-old male patient was referred to our department because of increased levels of gamma-glutamyl transpeptidase and alkaline phosphatase. Abdominal ultrasound scan showed a heterogeneous tumor located in the right lobe of the liver. Abdominal and thoracic CT as well as an abdominal MRI confirmed the presence of a heterogeneous tumor in the hepatic segment VI 11 cm in diameter, characterized by intense arterial uptake of the intravenous contrast followed by quick venous washout, without any sites suspicious for metastases. An ultrasound-guided biopsy of the mass, revealed the presence of a moderately differentiated HCC. The patient had a history of arterial hypertension, atrial fibrillation and diabetes mellitus type 2. Moreover, he was a smoker (50 pack-years) with a history of COPD classified as CAP C. Due to these comorbidities he was assigned to ASA-PS class III. He underwent laparoscopic resection of the hepatic segment VI, along with laparoscopic cholecystectomy. Operative time was 120 min. His postoperative course was uneventful and he was discharged on the 5<sup>th</sup> POD.

The histopathological examination of the surgical specimen showed a moderately differentiated HCC (G2) without vascular invasion (pT1) with clear surgical margins (R0 resection). The patient remains disease-free 20 months after surgery.

#### Case 5

A 62-year-old male patient was referred to our department for surgical treatment of a focal liver lesion discovered during his routine follow up for cirrhosis secondary to non-alcoholic steatohepatitis. The patient had a history of esophageal varices. Furthermore, he had an additional history of arterial hypertension, diabetes mellitus type 2 and his BMI was 31.1kg/m<sup>2</sup>. Due to these comorbidities, he was assessed as an ASA-PS III patient. He underwent a laparoscopic liver resection of segments VI and VII. Operative time was 180 min. The postoperative course was uneventful and he was discharged from hospital on the 5<sup>th</sup> POD. Histology report revealed a 3 cm moderately differentiated (G2) HCC without vascular invasion (pT1) and with tumor-free surgical margins (R0 resection). The patient remains disease-free 4 months after surgery.

## Discussion

ASA-PS scale is a very simple assessment tool used by anesthesiologists worldwide to estimate preoperative health status. There are 6 ASA-PS classes and the letter E is added if the surgery is urgent: I: a normal healthy individual, II: a patient with mild systemic disease, III: a patient with severe systemic disease, IV: a patient with severe systemic disease that is a constant threat to life, V: a moribund patient who is not expected to survive without the operation, and VI: a declared brain-dead patient whose organs are being removed for donor purposes. ASA-PS scale demonstrated validity as a predictor of perioperative risk, showing significant association with a wide variety of postoperative outcomes (morbidity, mortality, ICU length of stay) in different surgical populations.

It seems particularly important that higher ASA-PS class patients may avoid liver resection via laparotomy, which carries a higher risk of complications. Laparoscopic hepatic resections conferred all the significant benefits of laparoscopic surgery for the postoperative course of these patients with significant multiple comorbidities. Firstly, nonexposure of abdominal viscera restricts

fluid requirements and decreases electrolytic and protein losses, allowing a minimal impact on fluid and electrolyte homeostasis. Secondly, minimal tissue trauma lead to less postoperative pain and therefore reduces the need for analgesic medication. None of our patients required administration of opioid analgesics. This may be a benefit particularly for patients with a history of moderate to severe COPD (cases 1,3 and 4) or for morbidly obese patients (case 1). Avoidance of opioid-based postoperative analgesia resulted in no episodes of postoperative nausea and/or vomiting. As a consequence, early oral intake (2<sup>nd</sup> POD) was realized to all our patients and no episodes of postoperative ileus were noticed.

Three of our patients were assigned to ASA-PS class III or IV due to history of cirrhosis. For these patients all the advantages of LLR mentioned above were amplified, taking into consideration the high risk of complications these patients have when undergoing major open laparotomies. They all recovered rapidly without signs of severe deterioration of cirrhosis (ascites and jaundice).

One of the main concerns during hepatectomy is minimizing blood loss and avoidance of blood transfusion. As documented in several meta-analyses of comparative studies, intraoperative bleeding tends to be lower with the laparoscopic approach than with open resection [13,14]. Blood loss reported during laparoscopic liver surgery

varies between series, and is directly related to the type and complexity of the procedure [15]. Avoiding major blood loss results in decreased requirement for blood transfusion, offering one more advantage of LLR for high ASA-PS patients.

All of our patients underwent LLR for malignant disease. All resections were performed with tumor-free surgical margins (R0-resections). Importantly, no tumor recurrence and port site metastasis was noted during the follow-up period.

The present study suggests that LLR is a feasible and safe procedure for high-risk patients according to the ASA-PS classification. For ASA class III and IV patients who could undergo general anesthesia, performance of laparoscopic resection conferred all the advantages of laparoscopic techniques and resulted in satisfactory and uncomplicated postoperative courses. Thus, for surgeons who have developed skills in a stepwise approach and have reached high-complexity laparoscopic operations, LLR may become an optional treatment for improving postoperative outcomes of patients with severe comorbidities. Although many surgical series on LLR have been published, to the best of our knowledge this is the first study that explores the results of LLR in high ASA class patients.

## Conflict of interests

The authors declare no conflict of interests.

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