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Expert opinion on advanced techniques for hemostasis in liver surgery

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Abstract

Background: Reduction of perioperative blood loss and intraoperative transfusion are two major factors associated with improving outcomes in liver surgery. There is currently no consensus as to the best technique to achieve this.
Methods: An international Panel of Experts (EP), made up of hepatobiliary surgeons from well-known high-volume centres was assembled to share their experience with regard to the management of blood loss during liver resection surgery. The process included: a review of the current literature by the panel, a face-to-face meeting and an on-line survey completed by the EP prior to and following the face-to-face meeting, based on predetermined case scenarios. During the meeting the most frequently researched surgical techniques were appraised by the EP in terms of intraoperative blood loss.
Results: All EP members agreed that high quality research on the subject was lacking. Following an agreed risk stratification algorithm, the EP concurred with the existing research that a haemostatic device should always be used along with any user preferred surgical instrumentation in both open and laparoscopic liver resection procedures, independently from stratification of bleeding risk. The combined use of Ultrasonic Dissector (UD) and saline-coupled bipolar sealing device (Aquamantys®) was the EP preferred technique for both open and laparoscopic surgery.
Conclusions: This EP propose the use of a bipolar sealer and UD for the best resection technique and essential equipment to minimise blood loss during liver surgery, stratified according to transfusion risk, in both open and laparoscopic liver resection.

Keywords: Liver resection; Haemostasis; Sealing device

Introduction

Hepatic resection remains a challenging surgical procedure due to the risk of major bleeding during parenchymal transection compounded by the complex biliary and vascular anatomy of the liver.[1] In addition it remains one of the most common indications for blood transfusions[2] in surgery, reported to be required in up to 36% of patients, according to the type of resection and the technique used.[3–10]

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Prior to the introduction of modern transection techniques, mortality rates were high, mostly due to increased blood loss.[11] Although today, mortality rates are much more acceptable, as a consequence of major blood loss[11] excessive transfusion requirements[12] and biliary complications (5–15% rate of biliary leakage[11]), liver resection surgery is still associated with considerable morbidity.

Reducing the perioperative transfusion rate is a major factor in improving perioperative outcomes, both in open and in laparoscopic surgery, since it not only increases the risk of operative morbidity and mortality, but may also jeopardize long-term survival after resection of liver malignancies because the associated immunosuppression leads to a higher risk of tumour recurrence.[1,12–14]

Kelly-clasia (Clamp Crush technique) in combination with inflow occlusion (Pringle manoeuvre) has been used for many years to prevent bleeding during parenchymal transection. However, inflow occlusion is not without risk and may lead to hepatic ischemia reperfusion injury, especially in patients with decreased hepatic reserve.[15] In recent years, various novel devices including Ultrasonic Dissector (UD), LigaSure (bipolar sealer), Ultrasonic Scalpel, TissueLink (saline-coupled monopolar sealer), water-jet dissectors, Aquamantys® (saline-coupled bipolar sealer) and other devices for transection and coagulation of the liver parenchyma have been developed and used for hepatic resection alone or in combination, based upon liver function and the depth of liver resection.[14,16] The evidence base to support the use of these devices in reducing bleeding is incomplete and the optimal strategy for managing blood loss during liver parenchymal transection remains to be established.

Since there is no consensus on the best resection technique to minimise blood loss during liver resection, both in laparoscopic and open surgery the choice is still dependent upon the surgeons' experience and preference.[1,5,17–20]

Recognizing the limitations of the published evidence, an independent EP made up of hepatobiliary surgeons with extensive scientific and clinical expertise in the field of hepatic surgery with specific first hand experience in the use of all current haemostatic devices was brought together to ascertain and share opinion regarding the best resection technique and required instruments in order to minimise blood loss, stratified according to risk, in liver surgery.

Methods

The eight member panel was approached based upon their recognition and proven experience, in particular their clinical use of a wide range of haemostatic devices.

A three-step approach was implemented:

Step 1: A literature review on currently available haemostasis techniques and surgical devices for liver resection was conducted. MEDLINE and EMBASE databases were searched until January 2015 using the search strategies ("haemostasis, surgical" [MeSH] AND liver transection) and ("saline coupled" OR "saline linked" AND liver resection). A total of 114 publications were identified and the abstracts were reviewed. Out of these, 40 publications were selected by the panel for a detailed review while another 11 additional related papers were identified for reference; thus in total 51 papers were reviewed in detail by all of the EP members before the face-to-face panel meeting.

Step 2: The results of the literature review were analysed and debated in a face-to-face EP meeting held on May 2015. During this meeting, different case scenarios, ranging from routine to high risk patients, were presented by the EP Chairman and the following aspects were discussed by all of the panellists for both open and laparoscopy surgery:

- Risk factors associated with excessive bleeding;
- The Standard of care (SoC) technique;
- The need for inflow occlusion;
- Essential surgical equipment;
- Available equipment to be used in case of unexpected complications.

During the meeting, after the review of the published risk factors associated with major bleeding reported in the literature, EP members attempted to define the main bleeding risk factors for open and laparoscopic liver resection. They recognised the following high risk factors associated with open liver resection: cirrhosis, post-chemotherapy, re-operation, steatosis and pre-operative hyperbilirubinemia. For laparoscopic resections, cirrhosis, post-chemotherapy and re-operation were considered as the main bleeding risks factors, together with the position of the segment to be reached (e.g. segments 7 and 8). Major resections, 'fatty liver', tumour in proximity of hepatic veins, liver trauma and concomitant surgery were not considered as high risk bleeding factors by the majority of the EP members. EP members further stratified surgical procedures into two categories: standard procedure (defined as no risk factors present) and a high risk procedure (defined as having at least one bleeding risk factor present or in general judged at risk by the treating physician due to patient's clinical conditions).

Step 3: An on-line survey developed by the Chairman of the EP was sent to all members to establish the above discussed arguments. The survey answers were analysed to measure the level of agreement achieved by the EP members on the best resection technique and on the use of essential equipment to minimise blood loss in liver surgery, stratified according to risk, in both open and laparoscopic liver resection.

Results

Literature review

EP members agreed on the fact that the available Levels of Evidence concerning the best resection techniques to

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