

The Aquamantys® system as alternative for parenchymal division and hemostasis in liver resection for hepatocellular carcinoma: a preliminary study

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Abstract. – OBJECTIVE: To evaluate the clinical feasibility and safety of a new technique for liver resection using a new saline-coupled bipolar sealing device (Aquamantys®) that has shown high performance in the animal setting.

PATIENTS AND METHODS: Twelve Child-Pugh A cirrhotic patients with hepatocellular carcinoma underwent partial hepatectomies using Aquamantys®. Our primary end-point was to observe occurrence of early specific surgical complications as bleeding, biliary leakage and abscess development. Our secondary end-point was to evaluate local recurrence along resection margin after a minimum follow-up of 1 year.

Results: One bisegmentectomy, five monosegmentectomies and six atypical resections were performed. Mean resection time was 45 minutes (range, 30-100 min). Mean blood loss was 20 mL (range 5-80 mL). Mean post-operative stay was 6 days (range 5-16 days). All specimens presented negative margins (R0) at pathological examination. No blood transfusion were required both intra-operatively and post-operatively. No mortality was observed within 30-days post-operatively. One fluid collection occurred after 6-7 bisegmentectomy and was successfully treated by ultrasound-guided percutaneous drainage. At 1 year follow-up two patients died: one because of new lesions into the liver and one because of distant metastases and multifocal new liver disease. Ten patients are alive disease free at 1 year follow-up.

CONCLUSIONS: Liver resection using Aquamantys® is feasible and safe and allows to achieve almost bloodless parenchymal division with minimal necrosis and negative margins even in atypical resection. Comparative trials are needed to confirm our preliminary results.

Key Words:

Hepatocellular carcinoma, Liver resection, Aquamantys®.

Introduction

Liver resection provides the only potential cure for patients with hepatocellular carcinoma (HCC) not suitable for transplantation. Main goals of liver surgery in cirrhotic patients are preservation of enough liver substance to prevent postoperative liver failure¹, virtual bloodless resections to avoid blood transfusions, to reduce morbidity and mortality and to improve long-term survival by lowering tumor recurrence. Finally it is mandatory to obtain free resection margins. In fact, local recurrence is widely correlated to operative transfusion and to inadequate resection margins. Saline-coupled bipolar sealing is a new Food and Drug Administration (FDA)-approved technique for reducing intraoperative blood loss combining bipolar radio-frequency energy with continuously flowing saline at the electrode tip. This device has shown high performance in the animal setting in both parenchymal ablation and hemostasis². In the present paper the Authors present their experience using Aquamantys® during liver resection for HCC in liver cirrhosis. The primary end-point was to evaluate postoperative complications. Our secondary end-point was to evaluate local recurrence along resection margin after a minimum follow-up of 1 year.

Patients and Methods

Between November 2011 and December 2012 twelve Child-Pugh A cirrhotic patients with HCC underwent partial hepatectomies at our Institution using the saline-coupled bipolar sealing device. Cirrhosis was related to HCV infection in 5

cases, to HBV infection in 2 cases, to alcohol abuse in 4 cases and cryptogenic in one case. The mean age was 70 years (range, 65-80). Mean tumor diameter was 35 mm (range, 20-60 mm). All patients underwent preoperative assessment of their disease, including spiral computed tomography (CT), contrast-enhanced ultrasound and indication for surgery confirmed. Hepatectomy was performed through a vertical midline incision with right lateral extension. The liver was mobilized according to the size and site of the lesion to be resected. Intraoperative ultrasonography was routinely performed to exclude lesions not detected by pre-operative CT, to define the relationship between tumor and intrahepatic vessels. Hepatic transection was performed after applying the saline-coupled saline sealer (Aquamantys® System). The instrument was assembled according to the manufacturers' instructions. The Aquamantis Pump Generator was connected to the Aquamantis 9.5 XL Bipolar Sealer (Medtronic Advanced Energy). The device was used at the manufacturers' recommended settings for liver transection (170 W at a medium flow rate of 22 ml/mm). The device has been used applying the tip on tissue surface in a painting motion along resection margin or to spot-treat bleeding vessels. In this way structures 3-6 mm in diameter were sealed without producing high temperature or excessive charring and eschar. Structures more than 6 mm in diameter have been closed and divided in conventional manner with clips/ties and scissors. Constant suction was required to clear the saline used for irrigation. In all patients hepatic transection was performed without Pringle maneuver. After discharge a follow-up CT was scheduled at the first month and then every four months for the first year.

Results

All hepatic transections were performed using Aquamantys®. One bisegmentectomy, five monosegmentectomies and six atypical resections were performed. Mean resection time was 45 minutes (range, 30-100 min). Mean blood loss was 20 mL (range 5-80 mL). No blood transfusion was required both intra-operatively and post-operatively. No mortality was observed within 30-days post-operatively. One fluid collection occurred after 6-7 bisegmentectomy and was successfully treated by ultrasound-guided drainage. No liver insufficiency occurred. Mean

post-operative stay was 6 days (range 5-16 days). All resected specimens presented negative margins (R0) at pathological examination with a depth of tissue coagulation along the transection margin ranging from 3 to 5 mm. At 1 year follow-up two patients died: one because of new lesions into the liver and one because of distant metastases and multifocal new liver disease. Ten patient are alive disease free at 1 year follow-up.

Discussion

This paper describes the use of a new saline-coupled bipolar sealer to achieve parenchymal hemostasis prior to liver transection in case of HCC in patients suffering from liver cirrhosis. Perioperative blood loss and the possible requirement for blood transfusion are cause of major concern in liver surgery affecting postoperative complication rate and long term survival. In addition, limited liver function forces surgeons to spare as much normal liver as possible during resection to prevent postoperative liver failure. Furthermore, it has been hypothesized that unnecessary and excessive sacrifice of liver parenchyma leads to increased hepatocyte regeneration and might enhance hepatocarcinogenesis in the liver remnant³. Many studies^{1,4-7} have, therefore, investigated the possibility to reduce blood loss during liver resection, even in cases of non anatomical resections, with a variety of different methods. A range of techniques using the Harmonic Scalpel (Ethicon Endo-Surgery), the LigaSure (Covidien), the Cavitron Ultrasonic Surgical Aspirator (Integra CUSA Excel), the Habib Sealer and other devices are available to minimize bleeding during parenchymal transection but none has been demonstrated to be clearly superior to the others. As a consequence, the choice of transection technique is still dependent on the surgeons' experience and preference.

Saline-coupled bipolar sealing is a new Food and Drug Administration (FDA)-approved technique for reducing intraoperative blood loss combining bipolar radio-frequency energy with continuously flowing saline at the electrode tip. The saline used as conductive fluid cools the tissue surface, distributes energy on a broader area and allows a more efficient and safe sealing of vessels preventing the temperature from exceeding 100°C. Liver parenchyma is a highly vascular tissue containing hepatocytes suspended in a collagen extracellular matrix through which run vessels

and biliary structures. The thermal effect of Aquamantys® cause contraction of vascular collagen within the wall of small arteries, veins and biliary ducts stopping the flow of the fluid running into them. This coagulates tissue, sealing small vascular and biliary structures and isolating larger vessels and ducts that can be clipped and cut.

In this report, similarly to previous experiences^{8,9}, it has been shown that a minimal blood loss and no bile leaks is a possible target to meet using the new saline-coupled bipolar sealer.

Resection margin status is an important prognostic factor following liver resection and has implications for planning future treatments. It has been postulated that to prevent recurrence in HCC less than 30 mm a resection margin of 3 mm is sufficient (15-20% microsatellite lesions occurrence within 3 mm) while in HCC over 30 mm the resection margin should be widened up to 5 mm (40% microsatellite lesions occurrence within 3 mm)¹⁰. The Aquamantys® device produces a wide band of coagulation adjacent to the line of transection and disruption of extracellular matrix has been shown to reach a distance of 3 to 5 mm from the resection margin. The size of this area can be considered enough to obtain a safe resection margin even in case of larger lesions as shown, in our experience, by the absence of local recurrence after 12 months from surgery.

Some concerns of the proposed RF dissecting sealer must be addressed. First, coagulation of the tissue may preclude clear identification of the main blood vessels or main hepatic ducts. For this reason the device should be used with great caution close to these structures to avoid any damage. Second, some concerns are related to the destiny of the coagulated tissue on the transection plane which in theory could facilitate abscess formation or biliary leakage. Great care has been taken to leave, when possible, only two millimeters of coagulated tissue on the resection margin in order to achieve safe control of small blood vessels and bile duct and avoid abscess formation. In our study, following this rule, we had minimal blood loss and no bile leaks.

Conclusions

The proposed bipolar sealing device was shown to be safe and to achieve effective parenchymal division and hemostasis, resulting in reduced blood loss and negative margins, par-

ticularly in atypical resections and its use could be safe also in so called “frail patients, i.e. elderly and HIV-positive¹¹⁻¹⁸. However the preliminary results reported in this study need to be confirmed in prospective randomized trial comparing Aquamantys® with the other techniques more commonly utilized in liver surgery.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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