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REVIEW ARTICLE

Use of dissecting sealer may affect the early outcome in patients submitted to hepatic resection

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Abstract

Background. Many technological devices have been used to avoid intraoperative bleeding during hepatic parenchymal transection and to avoid morbidity and mortality, but until now none is complete. The aim of this work is to prospectively analyze hepatic resection patients treated with a water-cooled high frequency monopolar device in order to evaluate its effectiveness. *Patients and methods.* All consecutive patients who underwent liver resection by use of this device, between January 2003 until December 2007, were analyzed prospectively. The following variables were considered: age, sex, kind of disease, kind of liver resection, number of major/minor resections, total operative time and transection time, number and time of clamping, blood loss, time of hospitalization, morbidity, and mortality. *Results.* Between January 2003 and December 2007, 26 patients were analyzed prospectively (69% women, 31% men). Ages ranged from 18 to 84 years. Sixty-five percent of patients had a malignant disease; 35%, a benign disease. The procedures performed were two major hepatectomies (7.6%) and 24 minor hepatectomies (92.4%). Hepatic transection was performed in 35 to 150 min. Total operative time range was 120–480 min. The average blood loss was 325 ml (range 50–600 ml). The mean postoperative stays were nine days for all the patient and six days for non-cirrhotic patients. *Conclusion.* The water-cooled high frequency monopolar device is useful for reducing ischemia–reperfusion damage due to the Pringle maneuver and for reducing the risk of morbidity. However, the Kelly forceps remains the only inexpensive instrument really essential for liver surgery.

Key Words: *hepatic resections, liver surgery, technological devices*

Introduction

Liver resection is the most common therapy for many liver diseases. Much progress has been recorded since the first liver resection, performed by hand using the finger fracture [1]. The most popular and inexpensive method used for liver transection involves the use of a surgical clamp (Kelly clamp) to crush liver parenchyma, leaving intact vessels that can be tied or clipped. However hepatic resections are considered a major surgical procedure due to mortality and morbidity which continue to be too high; several studies [2–4] showed a relationship between liver surgery complications and blood loss. The Pringle maneuver [5] represents the most accepted procedure to prevent bleeding during parenchymal transection, even though it is controversial due to ischemic damage related to it.

In the last decades much technological effort has been concentrated on developing an instrument to allow a hepatic resection without clamping and bleeding. Some devices became very popular among hepatic surgeons and many high technological devices are available, but each of these devices has advantages and disadvantages and there is a lack of randomized controlled trials to compare these instruments and their costs [6].

In this article we prospectively analyzed patients treated for hepatic resection by a water-cooled high frequency monopolar device (Dissecting Sealer [DS], TissueLink®, Dover, NH, USA) in order to evaluate its effectiveness.

Patients and methods

All consecutive patients who underwent liver resection using this device, between January 2003 and Decem-

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ber 2007, were analyzed prospectively. The study group was composed of cirrhotic and non-cirrhotic patients.

All patients underwent a preoperative assessment of their disease by ultrasound and computed tomography (CT) scan; in cases in which the diagnosis was unclear, magnetic resonance imaging was used. In patients affected by malignant disease intraoperative ultrasound was employed to better define lesion margins and the presence of other lesions not well defined preoperatively. The following parameters were analyzed: age, sex, kind of disease, kind of liver resection according to Brisbane 2000 classification [7], number of major/minor resections (removal of three or more segments was considered as major hepatectomy), total operative time and transection time, number and time of clamping, blood loss (the suction volume after subtraction of rinse fluids and weight of swabs used during transection), pre and postoperative values of liver function test Alanine Amino Tranferase (ALT) and Aspartate Amino Transferase (AST) and total bilirubin determined daily for at least five days (liver function tests were analyzed separately for cirrhotic and non-cirrhotic patients), time of hospitalization, morbidity according to grade II of Dindo classification [8], and mortality.

All patients were treated with a laparotomic approach, using a water-cooled high frequency monopolar device (DS) (Figure 1) for parenchymal transection. This surgical instrument couples radiofrequency with a conductive fluid. Electrical energy is conducted through continuous low-volume saline irrigation and then into tissue where it is converted into heat by ohmic heating of the tissue. The saline facilitates energy transfer between the device–tissue interface, maintaining contact with the hepatic tissue and dispersing thermal energy [9]. Precoagulation of liver tissue is reached by denaturation of intramolecular crosslinks of the triple helix proteic structure and keeping the temperature of liver surface below 100°C to avoid development of eschar [10]. Vessels <3 mm are coagulated and larger structures remain isolated and can be tied or clipped during parenchymal transection performed with Kelly forceps. Hepatic tissue coagulated without eschar is softer, more friable, and easier to dissect through than tissue that has been charred at higher temperature [9]. At the end of the resection check of biliostasis was performed using methylene blue (a vital colorant) in all patients.

Results

Between January 2003 and December 2007, 26 patients were analyzed prospectively, 69% were women and 31% were men. Ages ranged from 18 to 84 years.

In the study group, 65% of patients had a malignant disease; 35%, a benign disease. Thirty-one percent were cirrhotic and were Child A grade. Malignant diseases included eight hepatocellular carcinoma, seven liver metastases, one cholangiocarcinoma, and one gallbladder carcinoma; benign diseases were one haemangioma, one focal nodular hyperplasia, one adenoma, one trauma, and five echinococcus cyst.

The procedure performed, according with Brisbane 2000 classification [7] were two right hepatectomies, two sectionectomies left lateral, eight segmentectomies, and 14 non-anatomical resections. Major hepatectomies were 7.6%. Pringle maneuver was necessary only in two cases (7.6%): one patient submitted to a major resection clamped for 3 min and one patient submitted to a minor hepatectomy clamped for 6 min. Hepatic transection using the DS was performed in 35 – 150 min. Total operative time range was 120 – 480 min. The average blood loss was 325 ml (range 50–600 ml). Pre and postoperative levels of liver function test and bilirubin for all the patients are reported, respectively, in Figures 2a, 3a, and 4a; values concerning only cirrhotic patients are reported in Figures 2b, 3b, and 4b; and values concerning non-cirrhotic patients are reported in Figures 2c, 3c, and 4c. The mean postoperative stays were nine days for all patients and six days for non-cirrhotic patients. We did not record any fluid collection or biliary fistula.

Discussion

Despite the success of liver surgery, blood loss and transfusions represent the most significant risk factors for poor outcome [10].

The Pringle maneuver, consisting of flow occlusion by clamping of the portal triad, represents the most accepted strategy to minimize blood loss during hepatic resections [11]. However the Pringle maneuver induces significant ischemic injury in the remnant liver that is strictly associated with the duration of occlusion. Moreover reperfusion increases ischemic damage by the interaction of oxygen and blood nutrients with hepatocytes and other types of cells present in the liver [12,13].

Figure 1. Water-cooled high frequency monopolar device (Dissecting Sealer [DS]; TissueLink®, Dover, NH, USA) for open surgery.

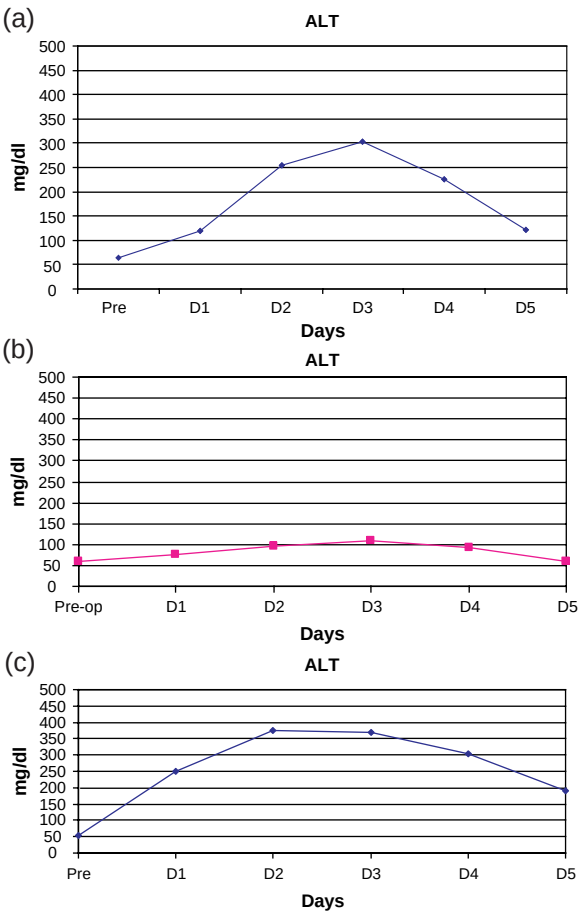

Figure 2. (a) Pre- and post-operative mean value of ALT of all patients, (b) Pre- and post-operative mean value of ALT in cirrhotic patients, (c) Pre- and post-operative mean value of ALT in noncirrhotic patients.

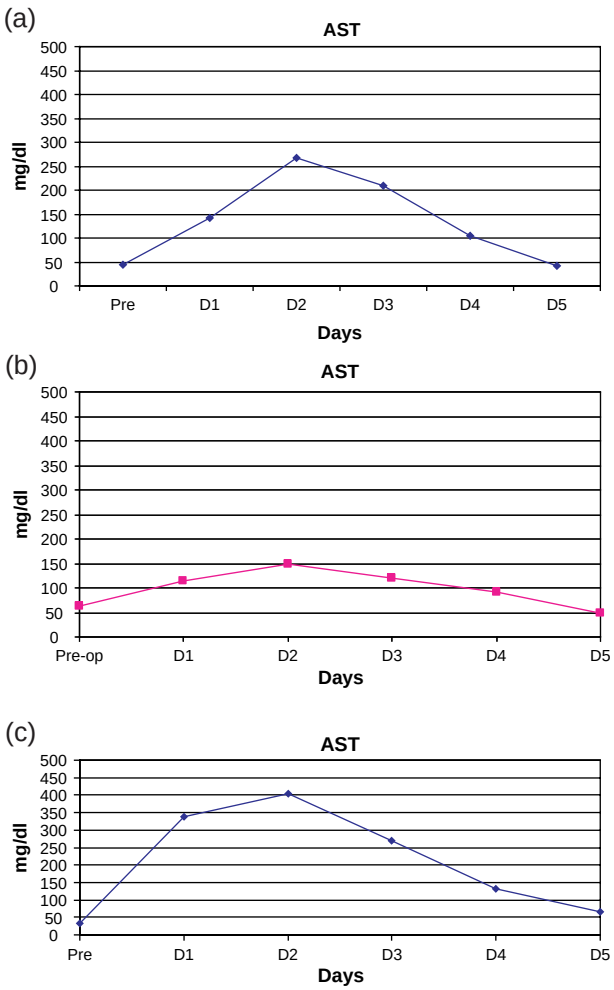

Figure 3. (a) Pre- and post-operative mean value of AST in all patients, (b) Pre- and post-operative mean value of AST in cirrhotic patients, (c) Pre- and post-operative mean value of AST in noncirrhotic patients.

Many strategies of clamping have been developed to avoid ischemia–reperfusion damage [14]; all of these strategies reduce liver damage, but cannot eliminate it. Common monopolar and bipolar electrocoagulation was used as the cheapest method to perform hemostasis and reduce blood loss, but they produce damage too far from the transection zone [15].

Several technologies have been recently developed for splitting the liver; these use ultrasonic dissection, radiofrequency, hydrodissection or stapling. All of these instruments are used to try to minimize blood loss during hepatic resection, and between these, the ultrasonic aspirator (CUSA® Valleylab, Boulder, NY, USA) is the most widely used [16], but it appears to have a high percentage of complications, especially of biliary fistula [17].

In our study, the DS did not have a positive impact on the speed of transection, which appeared similar to the times reported in literature [6,16–19] for the other devices and longer than the time necessary to perform resection with Kelly forceps alone [16–19]. DS reduced blood loss more efficiently than CUSA [6], Harmonic Scalpel (Ultracision, Ethicon Endo-Surgery Inc, Cincinnati, OH, USA) [16], and stapler [20], but less efficiently than Habib 4X® (Tyco Healthcare, Burlington Massachusetts, USA) [19] and Ligasure® (Valleylab, Boulder, NY, USA) [21]. It was also useful for reducing the number of Pringle maneuvers, which appear to be not necessary for major hepatectomies.

Patients in the present study showed a lower peak of liver transaminases and bilirubin than patients in others studies [18,19]; moreover, cirrhotic patients showed a lower peak than non-cirrhotic patients, probably in consequence of their lower parenchymal reserve. However, an increase in liver function tests is recorded in the literature for all patients after liver surgery, and it is more evident as expression of ischemia–reperfusion among patients who underwent the Pringle maneuver [11]. In our study patients, the majority of whom did not undergo clamping, increased liver function tests were probably due to manipulation of the liver [22]. That could also be due to damage from the radiofrequency energy, which is reported for ablative treatment using this kind of energy [23], but not for devices used for liver transection that use a lower energy for a shorter intermittent time. Bilirubin due to cholestasis caused by ischemic damage appeared to be higher. The time of hospitalization was similar.

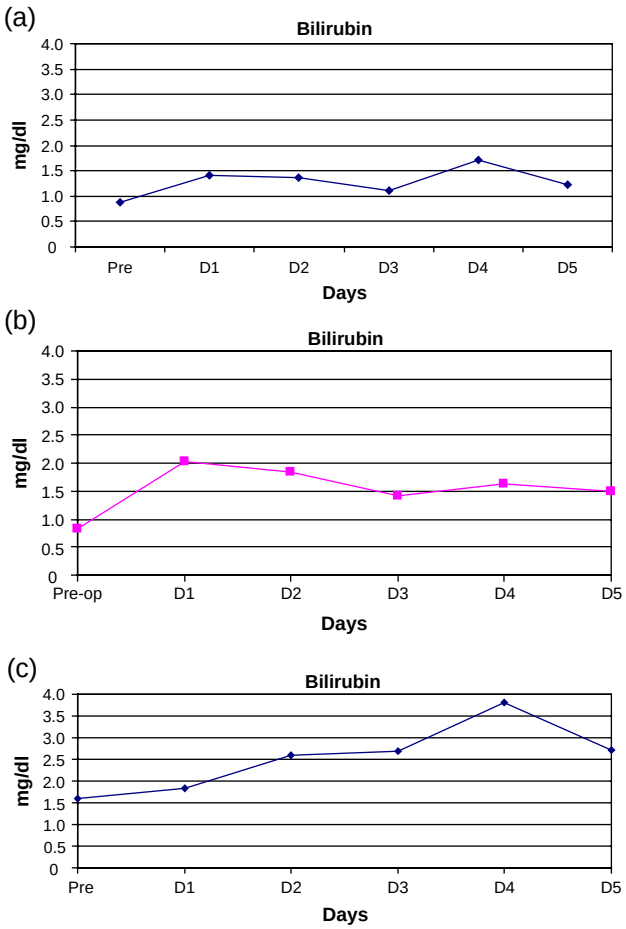

Figure 4. (a) Pre- and post-operative mean value of total bilirubin in all patients, (b) Pre- and post-operative mean value of bilirubin in cirrhotic patients, (c) Pre- and post-operative mean value of bilirubin in noncirrhotic patients.

In conclusion DS is a safe instrument for liver resection. It is certainly useful for reducing ischemia–reperfusion damage due to the Pringle maneuver and for reducing the risk of morbidity. However, its global impact is similar to the other devices, and Kelly forceps remains the only available inexpensive instrument essential for liver surgery. Many randomized, controlled clinical trials are necessary to better understand the real necessity for other instruments in liver surgery.

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