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Atypical Hepatic Resection Technique for Hepatocellular Carcinoma Using Radiofrequency Habib™ 4X Device

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Rezumat

Tehnica rezecției hepatice atipice în cancerul hepatocelular cu ajutorul pensei de radiofrecvență Habib™ 4X

Introducere: Numărul rezecțiilor hepatice a crescut semnificativ în lume în ultimii 20 de ani. În multe tumori hepatice rezecția hepatică este cea mai bună soluție terapeutică. Un obiectiv dificil intraoperator este realizarea unei hemostaze sigure la nivelul tranșei de rezecție. Dezvoltarea tehnologică din ultimele decenii a condus la realizarea unor instrumente care permit un control mai bun al sângerării şi o hemostază mai facilă şi rapidă.
Material și metodă: Am analizat prospectiv pacienții diagnosticați cu cancer hepatocelular la care s-a practicat rezecție hepatică atipică utilizând tehnica de radiofrecvență.
Tehnica chirurgicală: Am utilizat pensa bipolară Habib™ 4X, de unică folosință, conectată la generatorul de radiofrecvență. Tehnica este similară cu rezecția clasică doar că, după mobilizarea ficatului și efectuarea ecografiei intraoperatorii cu confirmarea tumorii, se realizează un plan circular de necroză de coagulare peritumorală cu ajutorul pensei Habib™ 4X. Secționarea parenchimului se realizează cu bisturiul rece.
Rezultate: Cu ajutorul acestei tehnici am operat 19 pacienți cu cancer hepatocelular. Volumul mediu de sânge pierdut intraoperator a fost de 170±90.7 ml. Durata medie a intervenției chirurgicale a fost de 118±58 min. Rata morbidității postoperatorii a fost de 32% (n=6), iar rata reintervenției a fost de 5.3% (n=1). Nu am avut nici un deces postoperator. Durata medie de spitalizare postoperatorie a fost de 11.6±5.1 zile.
Concluzie: Utilizarea pensei bipolare de radiofrecvență Habib™ 4X reduce timpul operator cu micșorarea volumului de sânge pierdut și scade morbiditatea și mortalitatea postoperatorie.

Cuvinte cheie: rezecție hepatică, cancer hepatocelular, pensa Habib 4X, dispozitivul de radiovrecvență, tehnica hepatectomiei nesângerânde

Abstract

Introduction: The number of liver resections significantly increased worldwide in the last 20 years. In many hepatic tumours, liver resection remains the best therapeutic option. A difficult intraoperative goal is to obtain a safe haemostasis on the transection plane. Technological innovation in recent decades allowed the development of different tools that allow better control of bleeding, faster and easier haemostasis.
Methods: We prospectively reviewed the patients diagnosed with hepatocellular carcinoma who underwent an atypical liver resection using a radio frequency (RF) ablation.
Surgical technique: We used a Habib™ 4X bipolar, handheld, disposable RF ablation device. The technique is similar to parenchymal approach, but after the operative ultrasound exam to confirm the tumour and resection plane and liver

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mobilisation, we perform a plane of coagulative necrosis around the tumour using Habib™ 4X. The parenchyme is then sectioned using the scalpel.
Results: 19 patients with hepatocellular carcinoma were included in this study. The mean operative blood loss volume was 170±90.7 ml. The mean operation time was 118±58 min. The postoperative morbidity rate was 32% (n=6) and the reintervention rate was 5.3% (n=1). We encountered no post-operative deaths. The overall mean postoperative stay was 11.6±5.1 days.
Conclusion: Bipolar radiofrequency device Habib™ 4X allows a shorter operative time with minimal blood loss and low rate of morbidity and mortality.

Key words: liver resection, hepatocellular carcinoma; Habib 4X device, radiofrequency ablation device, bloodless hepatectomy technique

Introduction

In the last two decades liver resection performed worldwide significantly increased. This is owed to the fact that liver resection is the only radical treatment for many liver tumours and to decreased postoperative morbidity due to stringent measures of preoperative preparation and postoperative care (1,2).

The treatment of choice, with curative potential, for malignant hepatic tumors is the anatomic or non-anatomic (atypical) R0 resection. Intraoperative bleeding remains the main complication and the blood loss volume is an important prognostic factor (3,4). Over time different surgical techniques extraparenchymal (Lortat-Jacob), intraparenchymal (Ton That Tung) or combined techniques (Bismuth) have been developed to allow a better control of vascular and biliary pedicles, to decrease the intraoperative blood loss (5). All these techniques use several types of pedicle clamping: (Pringle's manoeuvre, suprahepatic veins clamping or "total vascular exclusion"). Pedicle clamping effects on residual liver parenchyma (ischemia/reperfusion) may cause important liver damage for patients with impaired liver function, such as those with cirrhosis (6,7).

In the last decades technical developments have led to the development of different tools that allow the reducing of blood loss and a better control on haemostasis until the "bloodless liver resection": harmonic scalpel, Ligasure diathermy, argon diathermy, radio frequency ablation (RFA) techniques (8-10). The use of RFA devices to perform liver resection was described in 2002 by Weber JC et al (11). RFA allows the safe performing of both anatomical and non-anatomical (atypical) liver resection (9,12). Later, a bipolar handheld disposable RFA device (Habib™ 4x) was especially developed for liver resections (4).

Hepatocellular cancer (HCC) is developed in more than 80% of cases from a cirrhotic liver; especially in these cases, atypical resections are indicated because they allow the surgeon to preserve a larger volume of restant liver parenchyma, preventing post-operative liver failure (13). In our surgical unit we are using Habib 4X bipolar radiofrequency device to achieve atypical liver resection in HCC (4,14).

Surgical technique

Instruments

To achieve liver transection we used Habib™ 4X bipolar device (4). This device is handheld, consists of two pairs of opposing electrodes with an active end of 6 or 10 cm in length; the distance between two electrodes is 1 cm (*Fig. 1*).

The device is connected to a RITA 1500 generator that produces up to 250 W (4). The generator can run in manual or automatic mode.

Also, we used intraoperative ultrasound probe, usual surgical instruments and abdominal wall retractors.

Approach

The patient is placed on the operating table in the supine position, with right upper limb over the body and the left limb in abduction. We usually use a „J" shape incision (Makuuchi), but sometimes, depending on tumour site and size, we used subcostal, bisubcostal or midline incision (14).

Liver Exploration and Tumour Evaluation

After laparotomy, we carefully explore the peritoneal cavity. Then we perform a visual inspection of the liver and bimanual liver palpation to precisely locate the tumour(s), to evaluate the non-tumoral areas and to diagnose the eventual signs of portal hypertension. We usually take probes for bacteriological examination in case of ascites.

The liver exploration is completed by a preoperative ultrasound exam which allows to confirm the tumour's site and aspects with major vascular pedicles, as well as the diagnosis of unknown synchronous satellite tumours. For suspicious lesions we perform biopsies and frozen sections.

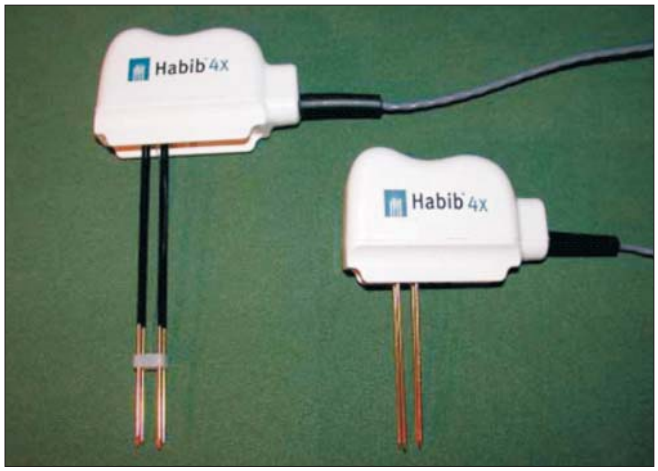

Figure 1. *Habib™ 4X bipolar radiofrequency device*

Liver mobilization

Liver mobilization depends on the tumour site; in tumours located in anterior segment sections we performed a limited liver mobilization by sectioning the round and falciform ligaments. For tumours located in posterior segments we section the coronary and triangular ligaments (*Fig. 2*).

We do not use routine hilar dissection and vascular pedicle isolation, neither suprahepatic vein dissection.

Cholecystectomy is not performed routinely; we performed it only if there were gallstones or when the transection line passed through the gallbladder bed.

Performing liver transection

After deciding to perform atypical liver resection the next important moment is marking the incision line. The resection line is marked on the liver surface at least 1 cm from the edge of the tumour using the electrocautery; it has to be all around the tumour. It is important that this line be drawn in the beginning because, after applying RF device, there appears an area of liver necrosis which makes palpation of tumour edges very difficult.

The device is then inserted perpendicularly in the liver parenchyma; usually we start on the diaphragmatic face. It is mandatory to check that the electrode tips are not outside of the liver and do not harm other organs. Then, we start the procedure; the RF generator provides a thermal necrosis in less than a minute. When necrosis is completed a warning sound is signalized; at this point the device is gently extracted, supporting the liver with the other hand. This procedure is repeated step by step, along the transection line, to hepatic necrosis area overlap. Depending on tumour site and volume this procedure can also be applied on the visceral liver face. The goal of the procedure is to obtain a "belt" of coagulated tissue surrounding the tumour (*Fig. 3*).

The coagulated tissue provides a safe haemostasis by sealing vessels and bile ducts; it also plays an important role as a cancer barrier sealing the tumour. Parenchymal section is then performed using the scalpel along the necrosis area in the middle of coagulated tissue (*Fig. 4*).

After resection completion we prefer to protect the coagulated area with TachoSil® to prevent adhesions and biliary leaks.

The procedure is completed by placing a drainage tube in contact with the resection slice. Abdominal wall is sutured in anatomic planes.

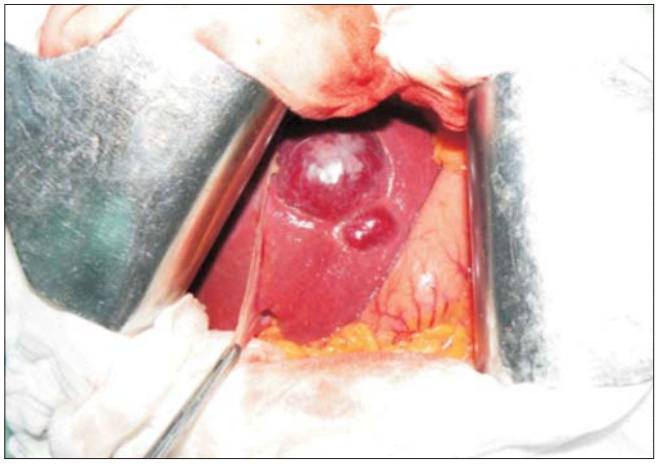

Figure 2. *Sectioning the falciform ligament in case of a tumour located in segment III*

Figure 3. *Performing termonecrosis using Habib™ RF device along the transection line*

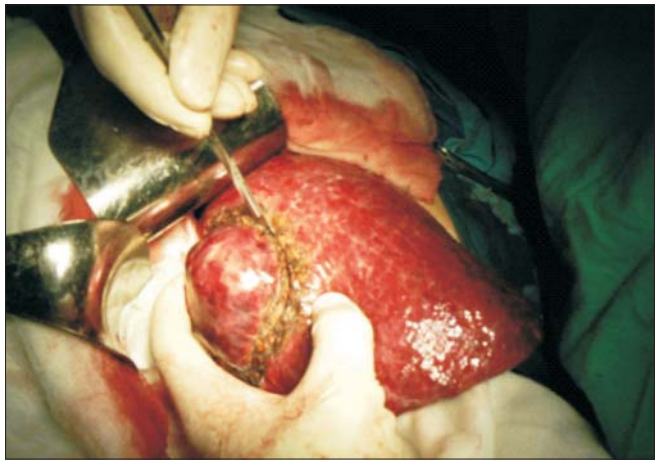

Figure 4. *Liver section using scalpel along the line of necrosis*

Results

Between January 2007 and August 2012 in our surgical unit 19 liver resections for hepatocellular carcinoma were performed using Habib™ 4X bipolar radiofrequency device. Demographic data and comorbidities of the patients are presented in *Table 1*.

The mean volume of perioperative blood loss was 170±90.7 mL. Six patients (32%) needed postoperative blood transfusion; however it has to be noted that 52.6% of the patients had a preoperative mild anaemia (mean haemoglobin: 11.4 g/dL; mean hematocrit: 34%).

Table 1. *Clinical data of patients with atypical liver resection*

Clinical dates	Patient number (19)	%
Mean age (years)	62.3± 9.1 (47 – 78)	
Sex (M/F)	14 / 5	74% / 26%
Associated diseases	18	95%
Diabetes	6	32%
Obesity	8	42%
Hypertension	9	47%
Cirrhosis	13	68%
Ascites	4	21%
Esophageal varices	6	32%

The mean operative time was 118±58 min. We used Pringle's manoeuvre in the first two cases.

The overall postoperative morbidity rate was 32% (n=6). The procedure-related postoperative rate was 5.26% (n=1): postoperative bleeding that required reintervention and haemostasis. We noted no biliary leaks and no abscesses. There was no postoperative mortality.

The pathological exams confirmed R0 resection in 17 cases and revealed a R1 in two cases.

The postoperative hospital stay was 11.6±5.1 days.

Discussions

Surgical resection is accepted as the most effective treatment for HCC for several reasons (15): 1) it is the only treatment that can lead to disease-free condition; 2) it allows a better surviving time, compared with the other treatment procedures, except for transplantation; 3) it allows a better quality of life than other therapies; 4) mortality and morbidity rates significantly decreased in the last decades because of improvements of surgical techniques, anaesthesia and intensive care.

The type of liver resection (typical or atypical) is decided after a careful preoperative imaging to determine the tumour site, number and volume as well as the volume of remnant parenchyma; liver resections has to respect the following goals: to allow a R0 resection, to preserve the biliary and blood vessels in the remaining liver parenchyma (10,15). For these reasons the procedure is virtually contra-indicated for central tumours (4,9). On the other hand the distance between the electrodes of Habib™ 4X of 1 cm virtually certifies the R0 resection; however, we encountered patients in our study with R1 resection, explained by tumour vicinity with vascular or biliary pedicles, in which the procedure is less feasible.

Even liver resection using Habib™ 4X device allows virtually bloodless liver resections, in some cases there may be a minimal bleeding which requires additional electrocoagulation, argon diathermy and/or application of haemostatic films (TachoComb®, TachoSil®, Gelaspon® etc.) (14,16,17). We advocate for the use of haemostatic products which prevent postoperative biliary leaks (17).

It is well known that intraoperative bleeding followed by blood transfusion is an important factor correlating morbidity and mortality in liver surgery (4,18,19). The average blood loss volume in liver atypical resection using RF assisted resection technique varies between 100 and 400 mL and significantly decreases blood transfusion requirements (8,20,21). The avoidance of pedicle clamping also prevents ischemia-reperfusion liver injury (22).

Postoperative complications rates, in patients with atypical liver resection performed, performed by this method, are variable. Pai M et al. (4) in a series of 384 liver resections performed with Habib™ 4X reported a postoperative morbidity rate of 21% with 1.6% biliary leaks. Ayav A et al. (9) noted a rate of 2.1% for bile leakage and no postoperative bleeding. On the other hand, a randomized study made in Italy, which compares RF liver resection with crush-clamp resection found a postoperative complication rate higher in the RF resection group (23); the most common postoperative complication was liver abscesses. To prevent this complication it is mandatory that the necrosis area remaining on the resection field be no larger than 1 cm (4,23). In our experience, the overall postoperative rate was 32% with one case of postoperative bleeding. We did not note any post-operative abscesses or biliary leaks; these results could be explained by a careful intraoperative technique, respecting the main vascular and biliary pedicles as well as the 1 cm margins of coagulated tissue and, perhaps, the use of TachoSil® for liver slice.

The operative time is significantly reduced using RF assisted liver resection technique; in different studies it varies between 60 and 150 min (4,11,13); in our study the mean operative time was 118 min.

The mortality rate varies in medical literature between 0 and 3,4% (4,13). In our series we encountered no postoperative deaths. This rate is significantly lower than that of "classical" liver resection techniques (3.2-10%) (2,15). The low volume of operative blood loss, the decreased operative time and the avoidance of blood transfusion apparently lead to the significant decrease of postoperative mortality (4,11,20,21, 24). To avoid postoperative complications and deaths a rigorous preoperative planning, including the assessment of postoperative liver volume and function, as well as tumour staging, is mandatory (25).

Conclusions

Atypical liver resection for HCC using bipolar RF ablation device is a feasible and safe procedure and allows a shorter operative time, less operative blood loss, low rate of morbidity and virtually no mortality.

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