Experience with TissueLink™ – Radiofrequency-Assisted Parenchymal Division

Rob Hutchins Marco Bertucci

HPB Surgery, Royal London Hospital, London, UK

Key Words

TissueLink™ · Radiofrequency-assisted parenchymal division

Abstract

Liver surgery has always been associated with blood loss, and the problem of bleeding, transfusions, and associated morbidity is a significant one. We present our experience using the TissueLink™ radiofrequency-assisted dissector for parenchymal division during hepatectomy. The TissueLink precoagulates liver parenchyma and allows for dissection of intrahepatic structures, allowing for near bloodless hepatectomy. We have demonstrated our results in terms of morbidity, mortality, blood loss and need for transfusion, and find that they are comparable with results from high-volume HPB centres. The TissueLink is an acceptable tool for use in hepatic transection and may result in less blood loss and lower transfusion rates than conventional methods of transection.

Copyright © 2007 S. Karger AG, Basel

Introduction

Historically the commonest cause of death from liver surgery was intraoperative bleeding. Advances in surgical technique, low CVP anaesthesia, cell salvage, and tis-

sue sealants have reduced this risk and along with it the requirement for allogenic blood transfusion. In addition to this, a number of new technologies have largely replaced the finger fracture or Kelly-clamp techniques of parenchymal division, in attempts to reduce blood loss and bile leaks [1]. These include the CUSA, the waterjet, and radiofrequency (RF)-assisted dissectors. The complexity of modern liver surgery demands that blood loss be kept to a minimum.

There are several reasons to avoid blood loss and associated transfusion. Obviously torrential bleeding leads to hemorrhagic shock, cardiovascular complications and possibly death. Long-term recovery, although debatable, may be adversely affected by blood loss and blood product administration [2, 3]. Blood products themselves are associated with morbidity. In the SHOT report (UK) 2004 there were 2,626 incidents associated with blood transfusions and over 3,500 near misses. Although this translates into a low risk per product transfused, blood products are far from benign. Incorrect product administration, acute transfusion reaction and transfusion-related acute lung injury have all led to patient death in the report [4]. Throughout Europe, new transfusion regulations are being introduced which will limit the availability of blood products. Surgical units will need to adopt strategies to reduce blood loss and surgeons must be willing to change their practice, if necessary, to comply with these guidelines.

Fig. 1. TissueLink™ probe in use dividing hepatic parenchyma: note the tan-coloured ablated not necrotic raw surface without bleeding.

This case series represents a single surgeon's experience using a commercially available RF probe for hepatic transection during liver resections (TissueLink™).

Patients and Methods

RF Probe

The RF instrument (TissueLink) uses RF energy, via a standard electrocautery generator, to produce heat conducted via a metal probe and saline irrigation. This pre-coagulates tissue without charring, sealing small vascular and biliary structures. The probe can also be used as a dissector, isolating larger structures in preparation for ligation (fig. 1).

Patients

Over a 30-month period, 125 cases were assessed. Eight were considered unresectable and unablatale and were referred for further treatment to an oncologist. Twelve cases were planned for resection but instead underwent open RF-assisted ablation due to findings at laparotomy. 105 (84%) patients underwent liver resection. Of 97 attempted TissueLink resections, 8 were converted to Kelly-clysis, giving a failure rate of 8.25%. The results of 89 consecutive TissueLink resections are reported. The indications for hepatic resection and patients' characteristics are shown in tables 1 and 2, respectively.

Procedures

Sixty-four (72%) of the resections involved two or more segments of the liver. Included in these procedures are 9 planned two-stage hepatectomies, and 2 re-hepatectomies for recurrent

Table 1. Indications

Colorectal metastases	57
Benign	9
Melanoma	5
Hepatocellular carcinoma	4
Neuroendocrine carcinoma	3
Cholangiocarcinoma	2
Gallbladder cancer	2
Gastric cancer	2
Unknown primary	2
Anal squamous cell carcinoma	1
Paraganglioma	1
Breast carcinoma	1

Table 2. Demographics and co-morbidities

Male	53
Median age, years	58.5
Preoperative chemotherapy	45
Portal vein embolisation	13
Ischaemic heart disease	3
Morbid obesity	2
Immunosuppression	2
Cirrhosis	2
Cerebrovascular disease	2
Aortic aneurysm	1
Restrictive lung disease	1
Hypertension	1
Jehovah's Witness	1
Pacemaker	1

Table 3. Procedure

Two-segment resection	23
Formal right/left hemihepatectomy	22
Single segment resection	15
Trisectionectomy	11
Non-anatomic resection	9
Three-segment resection	6
Four-segment resection	2
Longmire procedure	1

disease. Two of the trisectionectomies required additional wedge resections at the time of surgery, and one procedure required a portal vein resection and reconstruction. In addition to the hepatectomy, 10 cases required additional synchronous procedures. There were 8 synchronous colectomies, 1 adrenalectomy and 1 gastrectomy. All procedures are shown in table 3.

Results

Portal Clamping and CVP

Twenty-four patients required portal clamping with a mean clamping time of 5.8 min. There was no CVP control intraoperatively for any of the cases (table 4).

Blood Loss

Fifty-nine (66%) of patients did not require blood products, while 30 were transfused. Nine patients (10%) required only 1 unit, 12 (13.5%) were transfused between 1 and 3 units, and another 9 required >3 units of packed red cells (table 5).

Morbidity and Mortality

The one biliary stricture occurred early in the series during the learning curve with the TissueLink, due to collateral heat damage to the common hepatic duct from the saline runoff. This was avoided in future cases by avoiding any use of the instrument at the hilum, and protecting the structures with cool saline-soaked swabs. Of the bile leaks, one was related to damage at the CHD during portal vein resection, with the other four due to leaks at the raw edge, and thus attributable to the TissueLink technique (table 6). All lesions were completely excised, with a minimum of 5.2 mm clearance from the resection margin.

Discussion

Compared with large series from international high-volume HPB centres, we have achieved similar rates of morbidity and mortality using the TissueLink device for parenchymal division. Transfusion requirements are also comparable, and median blood loss is somewhat reduced [5–8]. Hence, it may allow for reduced blood loss compared with accepted standards, and as such can be considered a useful tool in liver resection. One drawback is the potential for high temperature saline to flow onto the extrahepatic biliary tree and cause biliary injury. We would recommend that the TissueLink is not used at the porta hepatis, and that cooled soaked swabs are placed over structures to be preserved.

Having demonstrated the safety and efficacy of TissueLink for liver transection, the question arises whether it compares favourably to the current standards. To address this, we are performing an RCT of CUSA versus TissueLink at the Royal London Hospital. We are randomizing 50 patients to each group, and using standard-

Table 4. Results

Inflow occlusion	24 (27%)
Mean clamping time, min	5.8
Mean operating time, h	3.9
Mean hospital stay, days	13.4

Table 5. Blood loss

Mean blood loss, ml	520
Median blood loss, ml	300
Mean transfusion requirement, units	0.9
Median transfusion requirement, units	0
Mean preoperative haemoglobin, g/dl	12.9
Mean discharge haemoglobin, g/dl	10.9
Patients requiring FFP (for INR >2.5)	5 (5.6%)
Patients requiring vitamin K (for INR >2.0)	7 (7.8%)

Table 6. Morbidity and mortality

Mortality	1 (1.1%)
Morbidity	18 (20%)
Bile leak	5 (5.6%)
Wound infection	5
Biliary stricture	1 (1.1%)
Abscess	1
Air embolus	1
Dehiscence	1
Line sepsis	1
Significant hypoalbuminemia	1
TIA	1
Drug-induced thrombocytopenia	1

ized anaesthetic monitoring, CVP control and transfusion triggers. The indication for resection, underlying liver status, use of preoperative chemotherapy, surface area of resection and volume of the specimen will be included in the study, with the endpoints being blood loss, transfusion requirements, morbidity and mortality. These results will be published in the near future.

In conclusion, TissueLink parenchymal division is safe, does not result in increased morbidity or mortality, and allows the surgeon to obtain adequate margins on the tumour.

References

- 1 DeMatteo RP, Fong Y, Jarnagin WR, Blumgart LH: Recent advances in hepatic resection. *Semin Surg Oncol* 2000;19:200–207.
- 2 Rosen CB, Nagorney DM, Taswell HF, Helgeson SL, Ilstrup DM, Van Heerden JA, Adson MA: Perioperative blood transfusion and determinants of survival after liver resection for metastatic colorectal carcinoma. *Ann Surg* 1992;216:493–505.
- 3 Kooby DA, Stockman J, Ben-Porat L, Gonen M, Jarnagin R, Dematteo RP, Tuorto S, Wuest D, Blumgart LH, Fong Y: Influence of transfusions on perioperative and long-term outcome in patients following hepatic resection for colorectal metastases. *Ann Surg* 2003;237:860–869.
- 4 Serious hazards of transfusion steering group. SHOT report 2004. <http://www.shotuk.org/>
- 5 Poon RT, Fan ST, Lo CM, Liu CL, Lam CM, Yuen WK, Yeung C, Wong J: Improving perioperative outcome expands the role of hepatectomy in management of benign and malignant hepatobiliary diseases: analysis of 1,222 consecutive patients from a prospective database. *Ann Surg* 2004;240:698–710.
- 6 Scheele J, Stang R, Altendorf-Hofmann A, Paul M: Resection of colorectal liver metastases. *World J Surg* 1995;19:59–71.
- 7 Jarnagin WR, Gonen M, Fong Y, DeMatteo RP, Ben-Porat L, Little S, Corvera C, Weber S, Blumgart LH: Improvement in perioperative outcome after hepatic resection: analysis of 1,803 consecutive cases over the past decade. *Ann Surg* 2002;236:397–407.
- 8 Belghiti J, Hiramatsu K, Benoist S, Massault P, Sauvanet A, Farges O: Seven hundred forty-seven hepatectomies in the 1990s: an update to evaluate the actual risk of liver resection. *J Am Coll Surg* 2000;191:38–46.