

Research Article

Comparative study of major liver resection using the harmonic scalpel and the crush-clamp method: A prospective study in a medical college hospital

Praveen Kumar Kundapur* and Erel Diaz

Department of General Surgery, Fr. Muller Medical College, Kankanady, Mangalore, Karnataka, India-575002

***Correspondence Info:**

Dr. Praveen Kumar Kundapur
Associate Professor,
Department of General Surgery,
Fr. Muller Medical College, Kankanady, Mangalore, Karnataka, India-575002
Email: drpkumar@yahoo.com

Abstract

The main problem which is experienced during liver resection still remains bleeding. Further complications include liver failure, hematoma, infections, and bile leakage. Various techniques have been developed for safe and careful dissection of the liver parenchyma. But none of the techniques can achieve complete haemostasis. We are describing prospective comparative study of major liver resection done using harmonic scalpel and the crush-clamp method, during 2011-2013 (3yrs).

Keywords: Liver resection, Harmonic scalpel and the crush-clamp method

1. Introduction

Traditionally, major hepatectomy was associated with a substantial mortality and morbidity¹. Dissection of liver parenchyma may cause considerable blood loss. Further complications include liver failure, hematoma, infections, and bile leakage. Various surgical methods have been developed for safe and careful dissection of the liver parenchyma. The methods range from basic finger fracture or the crush-clamp method, to devices based on more complex technology, such as ultrasonic or radiofrequency energy, water jet and tissue-sealing devices, and surgical staplers. The harmonic scalpel, otherwise known as the ultra-sonically activated scalpel, is a new surgical instrument for coagulation and cutting that utilizes ultrasonic vibration². The aim of the present study is to compare liver resection using the harmonic scalpel with the basic the crush-clamp method.

2. Materials and Methods

All the patients got admitted to Fr Muller Medical college Hospital for various types of liver tumours during 2011 to 2013 (3 yrs). All the patients underwent routine blood investigations, Tumour markers and triphasic CT scan liver. Only those patients who underwent major liver resections like right/left hepatectomy or extended hepatectomy are included in the study. Patients who underwent segmental resections are excluded from the study for homogeneity of the operations.

3. Results

In this prospective comparative study, 14 patients underwent major liver resections. 7 patients underwent right hepatectomy, 2 patients underwent extended right hepatectomy and 5 patients underwent left hepatectomy. First six patients underwent liver resection using the basic the crush-clamp method and later eight patients underwent liver resection using the

Harmonic scalpel since it was available for use in our hospital. In both groups, there were no significant differences in the age, sex ratio, preoperative status, tumour size, ratio of malignant to benign lesions, resection type, and volume of resected liver. Intraoperative data of both groups are described in table 1 and mortality, morbidity and hospital stay of both the groups are described in table 2.

Table 1: Intraoperative data of the patients operated by using the crush-clamp method and the harmonic scalpel

Introperative data	The crush-clamp method	The harmonic scalpel
Operating time (min)	210 min (182-252)	172 min (160-196)
Blood loss (ml)	1360 (1190-2030)	940 (770-1210)
Blood transfusion units (Packed RBC's)	6.3 (4-10)	4.1 (3-6)

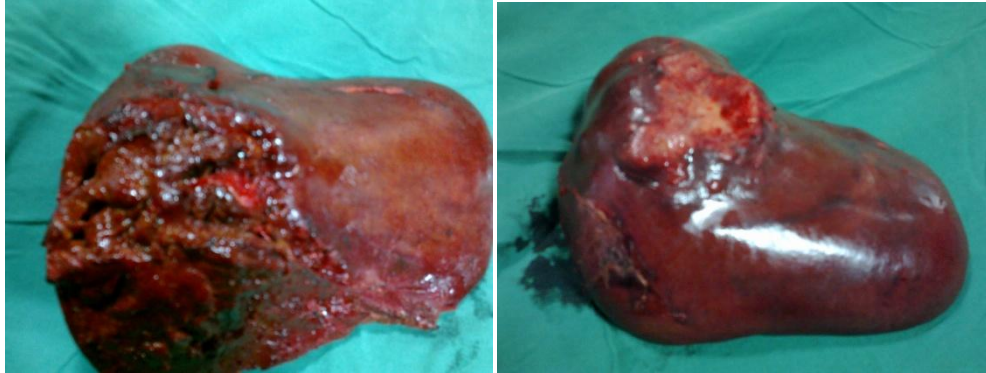
Table 2: Mortality, morbidity and hospital stay of the patients operated by using the crush-clamp method and the harmonic scalpel

Complication	The crush-clamp method	The harmonic scalpel
Bleeding (early post-op period)	2	0
Re-operation	1	0
Bile leak	6	8
Liver dysfunction after surgery	1	1
Death	1	0
Hospital stay (days)	32 (28-62)	38 (30-44)

Comparing the intraoperative data, mean operating time (min) and mean intraoperative blood loss, both were significantly more in case of the crush-clamp method compared to the harmonic scalpel group. In the early postoperative period, excessive bleeding as well as re-operation and mortality is more in case of the crush-clamp group compared to the harmonic scalpel group.

Postoperative bile leak is seen in all the patients in both groups. The mean postoperative bile leak was 19 days for the crush-clamp group compared to the mean postoperative bile leak for the harmonic scalpel group was 26 days. This clearly shows postoperative bile leak was significantly more in the harmonic scalpel group.

Fig No 1: Operative specimens of right hepatectomy.



4. Discussion

Despite standardized surgical techniques, liver resections still have a perioperative death of 4% to 20% and a high complication rate^{3,4}. During liver resection, bleeding control should be considered as one of the main priorities since it markedly reduces the postoperative morbidity and mortality^{5,6,7,8,9}. Various surgical methods have been developed for safe and careful dissection of the liver parenchyma. The methods range from basic finger fracture or the crush-clamp method, to devices based on more complex technology, such as ultrasonic or radiofrequency energy, water jet and tissue-sealing devices, and surgical staplers.

The crush-clamp method, which is the most basic strategy, involves crushing the liver parenchyma between the surgical clamps in order to expose and isolated small vessels and biliary radicals, which can then be divided. The crush-clamp method usually affords superior control when transecting the parenchyma as compared to finger fracture method. Division of vessels and bile ducts can be achieved by silk suture ligation, bipolar electrocautery, or vascular clips. Intermittent inflow occlusion with the Pringle manoeuvre is typically used during the transection. The crush-clamp technique has served as the point of reference for all other hepatic parenchymal techniques. A series of randomized controlled trials have analyzed and compared this crush-clamp technique with newer ones.

The harmonic Scalpel uses a principle of ultrasound energy applied to vibrating ultrasonic shears to seal and divide blood vessels up to 3mm in diameter. The vibration of the blades at 55,500 times per second simultaneously cuts and coagulates tissue by causing denaturation of proteins, rather than heat, as with conventional electrocautery. This allows for a more precise transection plane and reduces lateral thermal damage as well. In a nonrandomized study by Kim, *et al.* Use of harmonic scalpel was associated with decreased operative time and a trend toward decreased blood loss and transfusion requirement. Beside to the reduction in blood loss and operative time, one of the main advantages in the use of harmonic scalpel during liver surgery, seems the quality of the transection, during wedge or non anatomical resections, where the use of crush-clamping technique could lead to accidental intra-operative tumour exposure. However, it was also associated with a significant increase in the incidence of postoperative bile leak¹⁰. Higher biliary fistula rate was also found by Sugo *et al*¹¹. This might be related to the incomplete biliary duct sealing during dissection due to the different anatomical structure of the duct itself. Postoperative biliary leak can be minimized by intraoperative leakage test, if possible and meticulous suture ligation of leaking bile ducts.

5. Conclusion

The number of patients operated on with the harmonic scalpel in this study is too small to draw any final conclusion. Further it is not a controlled study comparing the harmonic scalpel with the crush-clamp method. However, our initial experience is promising, and on consideration of these data we believe that use of harmonic scalpel is associated with decreased blood loss, operative time and blood transfusion requirement. It is associated with a significant increase in the incidence of postoperative bile leak. Therefore, surgeons must be vigilant during liver parenchymal transection.

References

1. Foster JH, Berman MM. Solid liver tumours. *Major Probl Clin Surg* 1977; 22:1-342.
2. Amaral JF. The experimental development of an ultrasonic activated scalpel for laparoscopic use. *Surg Laparosc Endosc* 1994; 4: 92-99.
3. Tranberg KG, Rigotti P, Brackett K, *et al.* Liver resection: a comparison using Nd-Yag laser, an ultrasonic surgical aspirator, or blunt dissection. *Am J Surg* 1986; 158:368-373.
4. Wilker KD, Izbicki JR, Knoefel WT, *et al.* Das Saugmesser ("Suction knife") in der Leberchirurgie. *Chirurgie* 1990; 61:732-734.
5. Gozzetti G, Mazziotti A, Grazi GL, *et al.* Liver resection without blood transfusion. *Br J Surg* 1995; 82:1105-10.
6. Malassagne B, Cherqui D, Alon R, Brunetti F, Humeres R, Fagniez PL. Safety of selective clamping for major hepatectomies. *J Am Coll Surg* 1998; 187:482-6.
7. Dixon E, Vollmer Jr CM, Bathe OF, Sutherland F. Vascular occlusion to decrease blood loss during hepatic resection. *Am J Surg* 2005; 190:75-86.
8. Batignani G, Zuckermann M. Inferior approach for the isolation of the left- middle hepatic veins in liver resections: a safe way. *Arch Surg* 2005; 140:968-71.
9. Miyazaki M, Ito H, Nakagawa, *et al.* Aggressive surgical resection for hepatic metastases involving the inferior vena cava. *Am J Surg* 1999; 177:294-8.
10. Kim J, Ahmad SA, Lowy AM, Buell JF, Pennington LJ, Soldano DA, *et al.* Increased biliary fistulas after liver resection with harmonic scalpel. *Am Surg* 2003; 69:815-9.
11. Sugo H, Mikami Y, Matsumoto F *et al.* Hepatic resection using the harmonic scalpel. *Surg Today* 2000; 30:959-962.