Ultrasound aspiration hepatectomy for 136 patients with hepatocellular carcinoma

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AIM: To study the operative injury, post-operative complications, the hospitalization time, the post-operative survival rate of ultrasonic aspiration hepatectomy with a domestic new type of ultrasonic surgical device in comparison with that of conventional techniques of hepatectomy.

METHODS: A total 136 patients with hepatocellular carcinoma (HCC, including 12 patients in 1991 and 124 consecutive patients from July 1995 to December 2000) underwent ultrasonic aspiration in liver resection (group T) and 179 HCC patients received conventional hepatectomy during the corresponding period (group C). The results of the two groups were compared statistically.

RESULTS: There was no significant difference in the mean operation time between group T (152±11 min) and C (144±11 min). No operation or hospital death occurred in both groups. In group T, the mean volumes of bleeding (463±51 ml) and blood transfusion (381±12 ml) were markedly less than those in group C (557±20 ml, and 507±18 ml, respectively, P<0.05). The mean hospitalization time of group T (8.9±0.6 d) was markedly shorter than that of group C (11.7±0.6 d) (P<0.05). The incidence of complications in group T was markedly lower than in group C, post-operative jaundice occurred in 4/136 and 31/179, respectively (P<0.05), liver failure in 0/136 and 2/179, cholorrhea in 0/136 and 6/179, hydrothorax in 21/136 and 39/179 (P<0.05), ascites in 9/136 and 54/179, respectively (P<0.05). There was no significant difference in the 1-year survival rate between the two groups (P>0.05), while the 3-year survival rate of group T (64.2 %) increased markedly as compared with that of group C (55.7 %) (P<0.01).

CONCLUSION: The ultrasonic aspiration hepatectomy with a domestic new type of ultrasonic surgical device could evidently reduce the operative injury and post-operative complications, shorten the hospitalization time and prolong the survival of HCC patients.

INTRODUCTION

Hepatocellular carcinoma (HCC) is common in China [18-25], and its treatment is not satisfactory so far [11-17]. The first choice of treatment for HCC is hepatectomy, but the resectability is only about 4-20 % [18-25]. Therefore, it is important to improve the technique of liver resection and to increase the resectability. The invention of ultrasonic surgical device (also called ultrasound scalpel) is a breakthrough in medical field since the 1980s, it was also one of the developing hotspots in the surgery. The reason for its attention is that when compared with electric surgery unit, laser and microwave as well as other methods [26-36], it has many advantages including less lesion for the tissue in or around the operating field, less bleeding (or no bleeding), clear operating field, less operating risk, high security and more convenient to operate [17-40]. Since the 1990s, ultrasonic aspiration hepatectomy has been popularized in many European and American countries, and is now a standard technique of hepatosurgery [41]. Our study on 136 ultrasonic aspiration hepatectomies indicated that ultrasonic aspiration hepatectomy could reduce operative injury and the incidence of the major operative complication markedly. In the meantime, it could shorten the duration of hospitalization, reduce the blood transfusion during the operation, and raise the survival rate.

MATERIALS AND METHODS

Materials

From April 1991 to December 2000, we observed randomly (completely random design) 136 primary liver carcinoma patients (group T) treated by ultrasonic aspiration hepatectomy and 179 primary liver carcinoma patients (group C) treated by conventional technique. The ages of patients in group T and C were 13-72 years (mean 57±15 years) and 19-74 years (mean 55±16 years), respectively. There were 14 and 21 patients with intrahepatic metastasis in the group T and C, respectively (Table 1). NTY-300 multifunctional ultrasonic surgical device (made in China) was used. The equipment was composed of main unit that could work in multi frequency, several kinds of hand-pieces and control keyboard. It had multifunction of ultrasonic cutting, aspiration, and liposuction. The basic principle was that the computer device of the mainframe could produce electric signal ranging from 19 to 35kHz of frequency, and the signal was amplified by power amplifier, then sent to the hand-piece after impedance conversion by the output isolating transformer, thus producing ultrasonic vibration. At the same time, the sampling circuit could feed back the working status of the hand-piece to the computer device judging whether it was falling in the best working frequency. And the computer could modulate it automatically to assure that the portable therapeutic head fell in suitable resonance frequency to give...
the maximal ultrasound energy output. There are several simple control keys for manual operation on the control panel. And the corresponding parameters were displayed on the display monitor.

### Table 1 Clinical data of patients included in this study

| Main parameter            | Common hepatectomy (n=179) | Ultrasonic aspiration hepatectomy (n=136) |
|---------------------------|-----------------------------|---------------------------------------------|
| Mean age (yrs)            | 55±16                       | 57±15                                      |
| M/ F                      | 166/13                      | 128/8                                      |
| T/B (µ mol L⁻¹)           | 17.4±3.4                    | 16.4±1.5                                  |
| D/B (µ mol L⁻¹)           | 3.1±0.3                     | 3.0±0.3                                   |
| ALB/ (g L⁻¹)              | 40.0±7.0                    | 42.4±9.4                                  |
| ALT/ (nkat L⁻¹)           | 667.0±94.8                  | 538.1±51.2                                |
| AST/ (nkat L⁻¹)           | 602.6±50.8                  | 566.3±60.0                                |
| TT/ (g L⁻¹)               | 78.6±27.8                   | 73.3±28.2                                 |

### Methods

The bilateral subcostal approach, extended to the right as far as the midaxillary line, to the left as far as the lateral margin of the rectus muscle, and medially upwards the xiphoid process of the sternum (Mercedes incision) or a right subcostal incision extended along the median line (Invested-L incision) is the classic approach. JM-Ⅱ retractor (made in China) was routinely used for opening the abdominal wall. In the first stage the ligaments around the lobe to be resected were dissected until the lobe was mobilized. The liver to be resected was demarcated by cautery, and stitched to block the local blood supply. The ultrasonic aspirator was utilized in hepatoparenchyma dissection. Liver cells were broken and emulsified, and aspirated out of body. The intrahepatic canaliculi were exposed and canaliculi were dissected and ligated. The oozing sites were controlled by conventional methods.

### Statistical treatment

*t*-test and χ² test were used.

### RESULTS

There was no significant difference in the mean operation time between groups T (152±11min) and C (144±11min). No operation or hospital death of patients occurred in both groups. In group T, the mean volumes of bleeding (463±15 ml) and blood transfusion (381±12 ml) were markedly less than those in group C (557±20 ml, and 507±18 ml, respectively, *P*<0.05). The mean hospitalization time of group T (8.9±0.6 d) was markedly shorter than that of group C (11.7±0.6 d), (*P*<0.05).

The incidence of complications in the group T was significantly lower than in group C. There was no significant difference in the 1-year survival rate between the two groups (*P*>0.05), while the 3-year survival rate of group T (64.2%) increased markedly as compared with that of group C (55.7%), (Table 2).

### Table 2 Comparison of operation and treatment conditions between the two groups

| Main parameter                | Common hepatectomy (n=179) | Ultrasonic aspiration hepatectomy (n=136) |
|-------------------------------|-----------------------------|---------------------------------------------|
| Operation time/ min           | 144±11                      | 152±11                                     |
| Bleeding volume/ ml           | 557±20                      | 463±15                                     |
| Transfusion volume/ ml        | 507±18                      | 381±12                                     |
| Hospitalization day           | 11.7±0.6                    | 8.9±0.6                                    |
| Liver failure                 | 2                           | 0                                          |
| Postoperative jaundice        | 31                          | 4                                          |
| Cholorrhea                    | 6                           | 0                                          |
| Hydrothorax                   | 39                          | 21                                         |
| Ascites                       | 54                          | 9                                          |
| 1-year survival rate          | 92.5%                       | 94.8%                                      |
| 3-year survival rate          | 55.7%                       | 64.2%                                      |

*P* <0.05, *P* <0.01, vs Common hepatectomy.

### DISCUSSION

In the ultrasonic aspiration hepatectomy, semisolid liver tissue is broken and emulsified under the conjugated effects of ultrasonic shock acceleration and high-velocity liquid jet, and then is aspirated out by suction. Since most liver cancer patients (>90%) in China are complicated with liver cirrhosis [3-10], some researchers considered that it was difficult for the cirrhosis liver tissues containing plenty of connective tissue to be unbroken by ultrasonic knife. In fact, ultrasonic knife is just a common name, whose main function is not tissue-cut, but to expose intrahepatic canaliculi after breaking the cellular elements. For the intrahepatic fibrous tissue, the routine operative technique should be used [18-25]. Our data indicated that ultrasonic aspiration hepatectomy could significantly reduce the operative injury and the incidence of complication and shorten the mean hospitalization time by 3-4 days. Because of less blood transfusion required and tumor manipulation avoided in the operation, the 3-year survival rate of group T was higher than that of group C. The main technical advantages of this clinical application included (1) by the conventional operative procedure tissues are dissected with fingers, scissors or knife handle, and some fine canaliculi could not be exposed readily, so it is hard to avoid operative injury, which resulted in more bleeding during or after operation and higher incidence of cholorrhea. Ultrasonic knife can aspirate the liver tissues around the incision, the blood vessel and bile duct remained. The operators could ligate the vessel and bile duct perfectly, so cholorrhea and hematorrhea after operation may be avoided. (2) Ultrasonic knife is actually a kind of ultrasonic aspirator. According to the principle that the highly hydrated tissues could be emulsified easily, ultrasonic knife could aspirate the cellular debris out of body, but it cannot replace the conventional operative technique. (3) Since the main blood vessel and bile duct injuries can be avoided in the operation, the tumor near portahepatis can be cut off, thus it raises the resectability of liver cancer. Our first patient treated with this procedure was a 13 year old child with a tumor encroached on the first and second portahepatis. The pathologic diagnosis after operation was...
hepatocellular carcinoma. The patient has been remained well and alive up to 10 years. In the 136 operations, there were 64 complicated operations, 32 right liver lobe resections, 16 liver segment resections, 5 tri-liver lobe resections, and 2 left tri-liver lobe resections. (4) local block of blood flow could reduce bleeding in operation and assure the safety of hepatectomy, which is important in saving blood resources and accelerating the rehabilitation of patient. (5) ultrasound aspiration hepatectomy with no demand to block the portalhepatis, is especially suitable for the patients with impairment of liver function so as to avoid further injuries to liver parenchyma.

REFERENCES

1 Lin NF, Tang J, Hoteyi SM. Study on environmental etiology of high incidence areas of liver cancer in China. World J Gastroenterol 2000; 6: 572-576
2 Gu GW, Zhou HG. New concept in etiology of liver cancer. Shijie Huaren Xiaohua Zazhi 1998; 6:185-187
3 Yu SZ, Dong CH. Risk identification, assessment and control of primary hepatocellular cancer. Huaren Xiaohua Zazhi 1998; 6:1026-1029
4 Ji X, Pan BR, Ma JY, JI ZH, Ma LS. Gastroenterol in the beginning of new century—review and prospect. Shijie Huaren Xiaohua Zazhi 2000; 8:1161-1176
5 Tang ZY. Hepatocellular carcinoma cause, treatment and metastasis. World J Gastroenterol 2001; 7:445-454
6 Wu MC. Clinical research advances in primary liver cancer. World J Gastroenterol 1998; 4:471-474
7 Liu JP, Peng WW, Li MD, Li QF. Clinical significance of serum and liver j-2 microglobulin in patients with various types of HBV infection. Huaren Xiaohua Zazhi 1998; 6(Suppl 7):195-197
8 Liao HY, Lang ZW, Zhu RP, Cui BN, Li XM, Li Y, Weng L. The study of infection on hepatitis G virus in the tissue of hepatocellular carcinoma. Shijie Huaren Xiaohua Zazhi 1999; 7:491-493
9 Yuan FP. Huang PS, Wang Y, Gong HS. Relationship between EBV infection in Fujian HCC and HBV and PS3 protein expression. Shijie Huaren Xiaohua Zazhi 1999; 7:491-493
10 Deng ZL, Ma Y, Yuan L, Teng PK. The importance of hepatitis C as a risk factor for hepatocellular carcinoma in Guangzhou. World J Gastroenterol 2000; 6(suppl 3):75
11 Zhang BH, Liu Y, Qian GX, Chen H, Wu MC. The prognostic significance of detection of AFp and AFP after HCC resected. Huaren Xiaohua Zazhi 1998; 6(Suppl 7):125-126
12 Wu ZQ, Fan J, Qiu SJ, Zhou J, Tang ZY. The value of postoperative hepatic regional chemotherapy on the treatment of recurrence after radical resection of primary liver cancer. World J Gastroenterol 2000; 6:131-133
13 Ji W, Ma KS, Dong JH, Huang XL, He ZP. The stage II hepatectomy on hepatic cancer after selective portal vein embolization. Shijie Huaren Xiaohua Zazhi 2001; 9:1209-1210
14 Yamanaka J. Yumawaka N, Mikuni J, Sugawara T, Ono H, Fujiya T, Ikai I, Kume M, Sakai Y, Yamauchi A, Mikuni J, Sugawara T, Ono H, Fujiya T, Ikai I, Kume M, Sakai Y, Yamauchi A, Artifial Chemoembolization for Hepatocellular Carcinoma. Shijie Huaren Xiaohua Zazhi 1999; 7:158-160
15 Cheng SZ, Zhang HJ, Cheng YJ. Relative analization in the effects of percutaneous injecting several agents into hepatic neoplasm. Shijie Huaren Xiaohua Zazhi 2000; 8(suppl 8):88
16 Funj, Ten GJ, He SC, Guo JH, Yang MP, Weng GY, Artifial Chemoembolization for hepatocellular carcinoma. World J Gastroenterol 1998; 4:33-37
17 Huang DZ, Wu YD, Song XQ, Hu XH, Kang P. United treatment with iodine-125 oil embolism and local radioactive therapy on hepatic carcinoma. Shijie Huaren Xiaohua Zazhi 2001; 9:1198-1201 (in Chinese)
18 Fan J, Wu ZQ, Tang ZY, Qiu J, St M, ZC, Zhou XY, Ye SL. Multidimensionality treatment in hepatocellular carcinoma patients with tumor in portal vein. World J Gastroenterol 2001; 7:22-30
19 Yamamoto Y, Ikai J, Kume M, Sakai Y, Yamauuchi A, Shimohara K, Azuma K, Ito K, Shimamoto F. Laparoscopic-assisted hepatectomy for a large tumor of the liver. J Med Sci 1998; 47:163-166
20 Chen HY, Ker CG, Juan CC, Lo HW. Laparoscopic subsegmentectomy for hepatocellular carcinoma with cirrhosis: a case report. Kaohsiung J Med Sci 2000; 16:582-586
21 Gertsch P, Pelconi A, Guerra A, Krpo A. Initial experience with the 3rd generation scalpel in liver surgery. Hepatogastroenterology 2000; 23:3-736
22 Yamashita SY, Sakai S, Saemata T, Watanabe K, Iwasaki A, Shirakusa T. Thoracoscopic transdiaphragmatic microwave coagulation therapy for a liver tumors. Surg Endosc 1998; 12:1254-1257
23 Ji YC, Tian JM, Wang ZT, Chen D, Ye H, Liang J, Sun F, Lin L, Lu JP, Wang F, Cheng HY. A retrospective review on interventional treatment of 10000 cases of liver cancer. Huaren Xiaohua Zazhi 1998; 6:2-3
24 Tu SP, Wu DM, Yuan YZ, Wu YL, Jiang SH, Wu YX. Treatment of hepatocellular carcinoma by transcather arterial chemoembolization with hydroxycamptothecin. Shijie Huaren Xiaohua Zazhi 1999; 7:158-160
25 Cheng SZ, Zhang HJ, Cheng YJ. Relative analization in the effects of percutaneous injecting several agents into hepatic neoplasm. Shijie Huaren Xiaohua Zazhi 2000; 8(suppl 8):88
26 Funj, Ten GJ, He SC, Guo JH, Yang MP, Weng GY, Artifial Chemoembolization for hepatocellular carcinoma. World J Gastroenterol 1998; 4:33-37
27 Huang DZ, Wu YD, Song XQ, Hu XH, Kang P. United treatment with iodine-125 oil embolism and local radioactive therapy on hepatic carcinoma. Shijie Huaren Xiaohua Zazhi 2001; 9:1198-1201 (in Chinese)
28 Fan J, Wu ZQ, Tang ZY, Qiu J, St M, ZC, Zhou XY, Ye SL. Multidimensionality treatment in hepatocellular carcinoma patients with tumor in portal vein. World J Gastroenterol 2001; 7:22-30
29 Yamamoto Y, Ikai J, Kume M, Sakai Y, Yamauuchi A, Shimohara K, Morimoto T, Shimahara Y, Yamamoto M, Yamaoka Y. New technique for hepatic parenchymal resection using a Cavitron Ultrasonic Surgical Aspirator and bipolar cautery equipped with a channel for water dripping. World J Surg 1999; 23: 1032-1037
30 Trupka A, Hallfeldt K, Kalteis T, Schmidbauer S, Schweiberer L. Open and laparoscopic liver resection with a new ultrasound scalpel. Chirurg 1998; 69: 1352-1356
31 Kokudo N, Kimura H, Yamamoto H, Seki M, Ono H, Mabusabara T, Takahashi T. Hepatic parenchymal transaction using ultrasonic coagulating shears; a preliminary report. J Hepatobiliary Pancreat Surg 2000; 7: 295-298
32 Ouchi K, Mikuni J, Sugawara T, Ono H, Fujiya T, Kamiyama Y, Kagukawa Y, Yamamani H, Nakagawa K. Hepatectomy using an ultrasonically activated scalpel for hepatocellular carcinoma. Dig Surg 2000; 17: 138-142
33 Fan ST, Lai ECS, Lo CM, Chu KM, Liu CL, Wong J. Hepatectomy with an ultrasonic dissector for hepatocellular carcinoma. Br J Surg 1998; 85:117-120

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