

Single-Incision Laparoscopic Surgery in Liver Resection for Hepatocellular Carcinoma in Compensated Liver Cirrhosis

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Abstract

Background: Although trans-umbilical Single-Incision Laparoscopic Surgery (SILS) has been developing as an alternative to pure laparoscopic surgery or even natural orifice transluminal endoscopic surgery, ten reports of its use have yet been published in relation to liver resection. The aim of this article is to describe the SILS technique of liver resection for hepatocellular carcinoma in patient with compensated liver cirrhosis.

Methods: Through a 4-cm vertical trans-umbilical incision, 3 trocars (1 of 12 mm and 2 of 5 mm) were inserted. The tumor was located in a peripheral lesion of segment 3 in a 34-year-old man with compensated liver cirrhosis. Liver transection was performed using radiofrequency ablation and bipolar coagulation forceps as a precoagulative device and ultrasonically activated coagulating shears under 8-mmHg of carbon dioxide pneumoperitoneum. The Pringle manoeuvre was not used.

Results: The operative duration was 200 min and blood loss was 20 ml. No transfusion was required. The tumor size was 13 mm in diameter and the surgical margin was 10 mm. The postoperative course was uneventful. The patient had minimal postoperative pain and scarring and was discharged on the 6th postoperative day.

Conclusion: Our result suggests that SILS liver resection could be feasible and an effective alternative to traditional pure laparoscopic liver resection that provides a more minimally invasive surgical option and the ability to hide the surgical incision within the umbilicus in selected patients.

Keywords: Single-incision; Laparoscopic; Liver resection; Hepatocellular carcinoma; Liver cirrhosis

Introduction

Laparoscopic liver resection for a benign tumor was first reported in 1991 [1]. Thereafter, it has been spreading with development of devices used during the past two decades. Hashizume et al. described this procedure even for hepatocellular carcinoma [2]. Its feasibility with respect to survival and less invasiveness has been reported by some authors [3,4]. In the meantime, Noguera et al. [5] applied liver resection to transvaginal natural orifice transluminal endoscopic surgery (NOTES) [5]. NOTES comprise several new endoscopic and surgical entryways into the abdominal cavity with potential advantages of less invasiveness and the cosmetic. However, this technique is limitedly applied because it necessitates a visceral injury, leading to potential peritonitis. Actually, Noguera et al. performed hybrid NOTES necessitating transvaginal approach with 3 trocars to avoid peritonitis. Meanwhile, a Single-Incision Laparoscopic Surgery (SILS) has been developing as a minimally invasive surgery with cosmetic and painless benefits alternative to NOTES. SILS is a further minimally invasive technique using only one skin incision and has already applied to several surgical procedures including cholecystectomy [6-10], splenectomy [11], pyloromyotomy [12], sleeve gastrectomy [13], Roux-en-Y gastric bypass [14], appendectomy [15], and colectomy [16], equally to traditional laparoscopic surgery. However, ten reports of its use have yet been published in relation to liver resection to the best of our knowledge. In this report, we describe SILS liver resection for hepatocellular carcinoma in a patient with compensated liver cirrhosis.

Case

The tumor was located peripherally in segment 3 of the liver in a 34-year-old patient with compensated liver cirrhosis due to hepatitis B viral infection (Figure 1A). The informed consent for the single-incision laparoscopic liver resection was obtained. The patient was placed in the supine position with the surgeon on the right, the cameraman (first

assistant) on the left and the monitor at the shoulder level of the patient. The deepest point in the umbilical scar was detected, and the umbilicus was everted using graspers while applying subtle counter pressure on the abdominal wall to tent up the umbilical scar (Figure 2). A 4-cm vertical trans-umbilical incision was created and was deepened into the linea alba. A 12-mm ENDOPATH[®] EXCELTM port with OPTIVIEWTM Technology (Ethicon Endo-Surgery, Inc., Cincinnati, OH) was inserted. Pneumoperitoneum was maintained at 8 mmHg with carbon dioxide. A flexible-tip 5-mm scope was introduced. Visualization of the abdominal cavity and standard dissection of attachments were feasible as had been predicted with a preoperative three dimensioned image (Figure 1B). Two additional ENDOPATH[®] EXCEL[™] port with OPTIVIEW[™] Technology (Ethicon Endo-Surgery, Inc., Cincinnati, OH) of 5 mm were inserted laterally via separated fascial stabs through the same incision (Figures 3A and 3B). Liver transection was performed using radiofrequency ablation and bipolar coagulation forceps (BiClamp; Erbe Elektromedizin GmbH, Tübingen, Germany) as a precoagulative device and ultrasonically activated coagulating shears (Harmonic Ace; Ethicon Endosurgery, Inc., Smithfield, RI) without the Pringle manouvre. The resected specimen was retrieved through 12mm port site with the use of a catch bag.

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Received January 20, 2014; Accepted March 25, 2014; Published March 28, 2014

Citation: Oshita A, Tashiro H, Amano H, Kobayashi T, Ohdan H (2014) Single-Incision Laparoscopic Surgery in Liver Resection for Hepatocellular Carcinoma in Compensated Liver Cirrhosis. Transl Med 4: 126. doi:10.4172/2161-1025.1000126

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Figure 1: (A) CT showed a highly enhanced lesion at the periphery of segment 3 on arterial phase, leading to the diagnosis of hepatocellular carcinoma. (B) Three dimensioned CT revealed a predictive image on laparoscopic approach for peripheral tumor. (C) CT 3 months after surgery showed the complete removal of the tumor.



Results

The total operative time was 200 min. Estimated blood loss was 20 ml. The tumor size was 13 mm in diameter and the surgical margin was 10 mm. Postoperative course was uneventful. Length of postoperative hospital stay was 6 days. CT and the photo 3 months after surgery showed the complete removal of HCC and the cosmetic benefit of this procedure (Figures 1C and 4).

Discussion

Laparoscopic liver resection has been remarkably expanding over the last decade. Even malignant tumors have been treated with laparoscopic procedures and its feasibility with respect to survival and less invasiveness has been reported by some authors [3,4]. The development of laparoscopic liver resection leads in two directions. One is pure laparoscopic surgery and the other is hybrid laparoscopic surgery [17]. The goal of pure laparoscopic surgery may be NOTES liver resection. However, this technique is limitedly applied because it necessitates a visceral injury, leading to potential peritonitis. Actually, some authors performed hybrid NOTES combined with additional minilaparoscopy to prevent from peritonitis in some fields [5,18,19]. Therefore, SILS liver resection has been utilized as an alternative or a bridge to NOTES. SILS interventions have been already reported as minimally invasive procedures in many fields [6-16]. We herein describe the report of SILS liver resection for hepatocellular carcinoma.

While some authors underline that a single incision is made preferably in the umbilicus [20], the others recommend a supra-pubic single incision, allowing preservation of the umbilicus and resulting in a scar which is concealed within the pubic hair [21]. A trans-umbilical single incision would be cosmetic 3 months after surgery from our initial experience with 40 consecutive SILS cholecystectomies. Moreover, in SILS cholecystectomy, Solomon et al. [22] underlined the safety and the better learning curve using trans-umbilical incision [22], while Tsimoyiannis et al. [23] described its less invasiveness in terms of pain [23]. Therefore, it was also applied for SILS liver resection. A 4-cm incision is relatively large to insert three trocars including 1 of 12-mm and 2 of 5-mm. However, our initial case suffered from compensated liver cirrhosis and had portal hypertension, resulting in the dilated paraumbilical vein. Hence, a 4-cm incision was made to prevent from injuring it. The image taken 3 months after surgery revealed a satisfactory benefit on cosmetics. The author considers that a single incision could be minimized to 2.5- to 3-cm in size technically.

With regard to trans-abdominal access, some authors underline the usefulness of special devices including SILSTM port (Covidien, North Haven, CT, USA) in SILS cholecystectomy [22], Uni-XTM Single-Port Access Laparoscopic System (Pnavel Systems, Morganville, NJ, USA) in SILS colectomy [24] and the Gelport's double-ring wound retractor (Alexis^{*}, Applied Medical, Rancho Santa Margarita, CA, USA) in SILS



Figure 3: (A) The image of ENDOPATH[®] EXCEL[™] port with OPTIVIEW[™] Technology. (B) Single incision site during the intervention002E.



Figure 4: The photo taken 3 months after SILS liver resection.

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appendectomy [25]. However, our case did not need such a special instrument, resulting in an economical benefit. Pneumoperitoneum could be maintained only with XCELTM ports.

Concerning the surgical procedure, some surgeons perform SILS with the cross hand technique because SILS is limited by the co-axial arrangement of the instruments [26,27]. However, those problems can be overcome if the bilateral laparoscopic ports are inserted as far as possible. Actually, the cross hand technique is not necessary even in SILS cholecystectomy in our experiences. Endoscopic forceps do not fight in an appropriate use. Although it depends on the location of tumors, the authors guess that SILS liver resection can be performed using parallel technique.

SILS combines the cosmetic advantage of NOTES with the technical familiarity of the conventional multiport laparoscopic approach. In the present article, the authors presented the report, of a novel technique of SILS liver resection for HCC in a patient with compensated liver cirrhosis.

In conclusion, the authors believe that the single-incision transumbilical approach highlights the future direction of minimally invasive surgery even for liver resection while it is anticipated that new useful instruments will be developed to widen the indication. Also, the benefits of SILS liver resection have to be evaluated in a large series and if possible in a randomized prospective study

Acknowledgements

The authors thank Mr. Ishifuro, who is a roentgenological technician, for the cooperation of three dimensioned image.

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