Simplified Liver Splitting Technique Using a Curved Chang’s Needle
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Introduction
The author has been developing a technique for simplifying hepatic resections [1-4] and intrahepatic inflow/outflow control [3,4] by using whole-thickness mattress sutures applied with a long straight needle; however, the liver over the inferior vena cava is a limitation for such a whole-thickness liver-puncture maneuver. To overcome this obstacle, a modification has recently been made to a long curved needle to make whole-thickness mattress sutures along the division line of the remnant liver above the inferior vena cava to control bleeding, and then bloodlessly splitting the liver with scissors within 40 min in a case of a left lobectomy with metastases from breast cancer. The patient was uneventfully discharged on the fourth postoperative day.

Materials and Methods
A 51 year old woman was referred to our department for left-lobe liver metastases secondary to breast cancer. Three years previously, she had undergone a left-side mastectomy and, one year later, was multiple recurrences of liver tumors. Since then, she underwent chemotherapy and target therapy, and the tumors almost completely disappeared. Last year, however, the liver tumors recurred in left lobe. She came to seek a possibility of surgical resection. After careful evaluations for the surgical indication, she was given an open left hepatic lobectomy in August, 2012. After the laparotomy, intraoperative ultrasonography showed four tumors in the left lobe. The operation was started with a suture ligation of the extrahepatic left Glissonian pedicle using a No. 1 silk with a conventional curved needle (Figure 1 #1). Two overlapping interlocking whole-thickness mattress sutures (3-5 cm wide) were then made from the lower liver border upward with our self-designed long curved needle (Figure 2), bent from a long straight Chang’s needle (19 cm), by puncturing from liver bottom toward the liver surface along the division line of the remnant side liver above the inferior vena cava (Figure 1 #2-#9). This procedure enabled the surgeon to cut a one-knot-length (3-5 cm wide) liver parenchymal division using scissors (Figure 1 #10). Surprisingly, the liver did not bleed. The third knot was applied upward and the second knot-length liver parenchymal division followed with the same bloodless result (Figure 1 #11). Finally, the fourth knot reached the upper border of the liver, and the rest of the liver division was completed (Figure 1 #12) with scissors as well. After liver splitting had been completed, the left hepatic lobectomy in the current case.

Abstract
Liver-splitting techniques been previously developed for ex vivo and in situ cadaveric liver transplantation, and more recently for in situ living donor liver transplantation or liver partition with a portal vein ligation for a staged hepatectomy. We report a novel and simplified technique using a long curved needle to make whole-thickness mattress sutures along the division line of the remnant liver above the inferior vena cava to control bleeding, and then bloodlessly splitting the liver with scissors within 40 min in a case of a left lobectomy with metastases from breast cancer. The patient was uneventfully discharged on the fourth postoperative day.

When a liver lobectomy or partition to enhance liver regeneration for a staged hepatectomy is necessary, this technique can be done straightforwardly without concern for the problems of venous return or congestion of the recipient or remnant donor liver. This technique is probably the simplest and fastest way for any surgeon and any facility.

Keywords: Hepatic lobectomy; Liver transplantation; Liver splitting; Staged hepatectomy; Liver partition; Chang's needle; ALPPS

Figure 1: Schematic representations of the current technique used for a left hepatic lobectomy in the case.
hilar Glissonian structures and the left hepatic vein were dissected and ligated, respectively. Neither fibrin sealant nor a coagulation product was used. A Jackson-Pratt drain was placed along the resected area before the abdomen was closed.

Results

The parenchymal transsection—4 whole-thickness interlocking mattress sutures and liver splitting (parenchymal division) using scissors—required only 40 min and there was no bleeding. Procedure-related complications, such as postoperative bleeding, bile leakage, liver infarction, liver abscess, subphrenic abscess and ensuing sepsis, were not encountered. The patient recovered uneventfully and was discharged on the 4th day post-operation.

Discussion

Liver splitting has been used since 1987 as an ex vivo [5-7] (one liver for two grafts) technique and since 1988 as in situ [8-11] (left lateral segment form living donor liver) technique increase liver grafts for pediatric liver transplantation. Since then, splitting techniques have been used for in situ [12,13] cadaveric liver transplantation, living donor transplantation using the right lobe for children [14] and adults [15] and recently for patients with insufficient liver capacity patients who need liver partition, and concomitantly with portal vein ligation to increase liver regeneration for staged hepatectomy [16] (ALPPS).

Currently, ultrasonic dissectors and coagulators are used for liver splitting without vascular control for right-lobe grafts in living-donor liver transplantation; however, significant blood is lost and more than 6 h of surgery (first 11 donors, range 10.1-15.5 h) [17] is usually necessary. Pringle’s maneuver and selective vascular control [18] during the parenchymal transection may be used to control recalcitrant bleeding.

Other than currently used parenchyma transection devices the author has been developing a technique for simplifying hepatic resections [1,2,4] and intrahepatic inflow/outflow control [3,4] by using whole-thickness mattress sutures applied with a long straight needle since 1996; however, the liver over the inferior vena cava is a limitation for such a whole-thickness liver-puncture maneuver. To overcome this obstacle, a modification has recently been made to a long curved needle to enable liver puncturing from the bottom of the liver to the top. The history of suture-compression technique for liver resection can be traced back to 1896 when liver operation was begun and since then straight and curve needles had been applied [19]; however current report is the first application of long curved needle on liver splitting and left hepatic lobectomy. The speedy and bloodless results have beyond the author’s imagination.

The author’s curved needle maneuver can simplify the cumbersome and time-consuming parenchymal transection procedures using scissors in cases of a left lateral segment graft for pediatric liver transplantation or in parts of the right- or left-lobe graft procurement procedures, for which meticulous dissection along the middle hepatic vein is not needed. Liver-splitting or partition time and blood loss can be reduced. Because no hilar or vascular control is required, ischemic injury can be obviated for the graft or donor remnant liver. Hilar structures can be approached after parenchymal splitting, in which case any unnecessary injury to the blood supply of the bile duct [13,17] can be minimized.

Conclusion

When a liver lobectomy or partition to enhance liver regeneration for a staged hepatectomy is necessary, this technique can be done straightforwardly without concern for the problems of venous return

Figure 2: A curved Chang's needle.

Figure 3: Schematic representations of the current technique used for liver splitting.
or congestion of the recipient or remnant donor liver. This technique is probably the simplest and fastest way for any surgeon and any facility.

Conflict of Interest
Authors have no conflict of interests to declare.

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