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BRIEF REPORT

OPEN

A comparative study between stapled and sutured side-to-side cavo-caval anastomosis for outflow reconstruction in deceased donor liver transplants

To the editor,

Venous outflow reconstruction is traditionally a sutured anastomosis in deceased donor liver transplants. It may be technically challenging in patients with a deep abdomen or large grafts, especially for trainee surgeons. A stapled anastomosis may be faster and easier. Stapled anastomoses have only been described in experimental and rescue settings.[1–3] We describe the technical nuances of stapled side-to-side cavo-cavostomy (SSCC) in this controlled matched study and compare its feasibility, safety, and outcomes with sutured SSCC in deceased donor liver transplants.

We retrospectively analyzed all nonpregnant adults who underwent a primary deceased donor liver transplant with SSCC at Global Hospital, Mumbai from July 2018 to June 2019. Stapled SSCC was compared with sutured SSCC in a 1:2 ratio matched for the donor type (standard or extended criteria), MELD score (±4), Child-Turcotte-Pugh (CTP) score (±2), and recipient age (±5 y). The perioperative care remained unchanged between both groups.

SURGICAL DETAILS

- Procurement of the donor liver graft was performed using standard techniques.
- On bench surgery, for sutured SSCC, both supra-hepatic and infra-hepatic graft IVC orifices were sutured. For stapled SSCC, the supra-hepatic graft IVC was stapled anteroposteriorly with a linear non-cutting stapler with a vascular (white) cartridge to avoid the possibility of the anastomotic stapler cutting through the suture line. The infra-hepatic graft IVC was either sutured or stapled.
- Recipient hepatectomy was performed using the cava-preserving technique in all cases.
- For stapled SSCC, retro-caval dissection was done, and lumbar veins were divided. All steps were performed with the surgeon standing on the right side of the patient.
    - RHV and MHV-LHV were divided using linear staplers with vascular (white) cartridges. The IVC was cross clamped supra-renally and infra-phrenically.
    - Ten mm venotomies were performed in caudal segments of the anterior wall of the recipient IVC (Figure 1A) and the posterior wall of the donor graft IVC (Figure 1B). Stay sutures were placed in the donor IVC next to the cavotomy.
    - The stapler (Echelon, Ethicon Inc., Somerville, NJ, USA) was fully angulated to the left, and the thicker arm with a 60 mm vascular cartridge (GST60W, Ethicon Inc., Somerville, NJ, USA) was introduced into the donor IVC on the bench. The surgeon standing on the right side of the patient held the stapler in position, while the first assistant standing on the left side lifted the liver and brought it into the field. The liver was then placed in the anatomical position, and the thinner arm was introduced into the recipient IVC. Traction was given on the previously placed stay sutures to ensure a smooth anastomotic line.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; ECD, extended criteria donor; HPB, hepato-pancreatico-biliary; HPS, hepato pulmonary syndrome; HT, hypertension; IHD, ischemic heart disease; MELD, Model for End-Stage Liver Disease; SSCC, side-to-side cavo-cavostomy.

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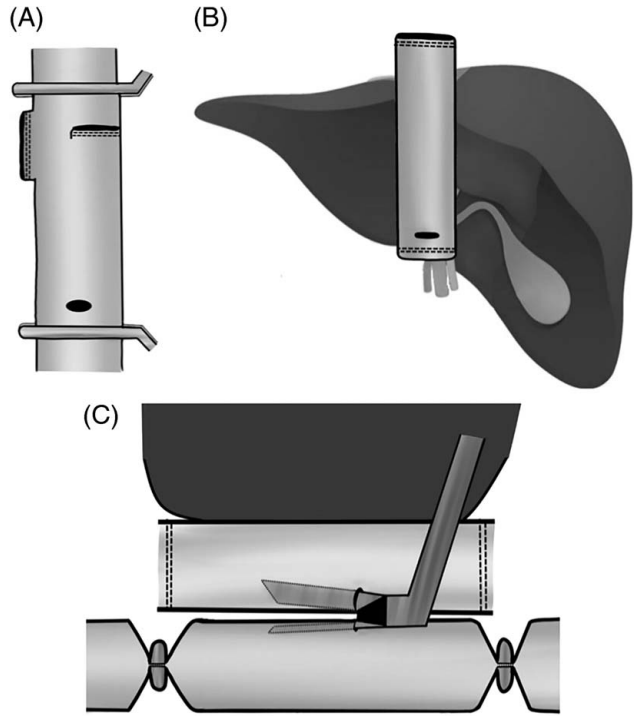

FIGURE 1 (A) Ten mm venotomies performed in caudal segments of anterior wall of recipient IVC after cross clamping. The stapled orifices of RHV and LHV can be seen in the cranial segment of the figure. (B) Ten mm venotomies were performed on the posterior wall of donor graft IVC. (C) The thinner arm of a vascular stapler is introduced into the recipient IVC and SSCC anastomosis is completed by closing both arms and firing the stapler.

  - SSCC anastomosis was completed by closing both arms and firing the stapler (Figure 1C) (video 1, http://links.lww.com/LVT/A444).
  - In the first 8 patients, the anastomosis was done with a single 60 mm stapler, whereas in the subsequent cases, another 40 or 60 mm stapler was fired for the superior end of the anastomosis to reach above the right/middle or left hepatic vein staple lines.
  - UW solution in the graft was flushed out by cold normal saline through the portal vein.
  - The liver was elevated and the venotomy site was closed using continuous 5/0 polypropylene sutures from left to right.

- Sutured SSCC anastomosis was performed using standard techniques with IVC side clamp.
- All other anastomoses (portal vein, hepatic artery, bile duct) were performed in the standard fashion.
- The graft was re-perfused after portal vein anastomosis.
- Doppler US was performed after hepatic artery anastomosis.
- Two abdominal drains were placed to record drain output. Drains were generally removed between postoperative days 5 and 7.

RESULTS

Seventeen patients underwent stapled SSCC and were compared against 34 matched controls. Patients in both groups were comparable with respect to demographics, severity of liver disease, and operative times (Supplemental Table 1, http://links.lww.com/LVT/A443).

The anastomosis time (21.9 ± 10.4 vs. 29.3 ± 11.2 min, $p = 0.03$) and the warm ischemia time (36.9 ± 10.4 vs. 44.3 ± 11.2 min, $p = 0.03$) were significantly shorter in the stapled group (Supplemental Table 2, http://links.lww.com/LVT/A443).

None of the patients in either group had hepatic venous outflow obstruction or IVC narrowing intraoperatively or postoperatively. Three patients in the stapled group had high drain output. There was no other evidence of a suboptimal outflow in the stapled group. Stapled SSCC anastomoses were found to be patent on follow-up CT scans in 13 (76.4%) patients in the group; no imaging was done in others. The rates of postoperative renal dysfunction were comparable. We observed an early allograft dysfunction in 8% of the cases in the sutured group, while none of the patients in the stapled group had early allograft dysfunction. There was no perioperative mortality in stapled SSCC group. There were 4 perioperative mortalities in sutured SSCC group, with sepsis being the most common cause. The median intensive care unit and hospital stay were similar.

DISCUSSION

In our experience, this new technique offers several advantages. It simplifies outflow reconstruction in cases with deeper abdominal cavities or larger grafts. By significantly reducing the warm ischemia time this technique may contribute to improved surgical outcomes. The shorter anastomosis and, thereby, the IVC clamp time may explain the similar rates of postoperative renal dysfunction despite complete caval clamping. This technique also mitigates the risk of injuring the thin venous wall while suturing in depth, and the constant inter-staple distances ensure a smoother anastomosis line.[1] Furthermore, since multiple stapler fires are possible, the anastomosis diameter can be widened at any point, which is not possible in the sutured approach. The optimal length of the anastomosis is not able to be determined from our early experience. A longer stapled anastomosis might improve venous outflow, but our study was not sufficiently powered to determine optimal anastomosis size. Ultimately, the independence of the anastomosis from the surgeon's ability makes this technique more reliable and reproducible by even junior transplant surgeons. All surgeons of our transplant team could perform a stapled SSCC, even in difficult cases.

However, it is also important to recognize and discuss the potential pitfalls of this technique. This technique mandates caval cross-clamping and might not be suitable for patients with preoperative renal dysfunction. Further research is also required to evaluate the effects of a stapled SSCC on postoperative drain output. Device-related mechanical failure is another potential complication that needs to be kept in mind.

Over a median follow-up of 266 days, our results with the stapled approach have been fairly encouraging. However, the consequences of a stapled anastomoses on any future re-transplant have yet to be ascertained, and the added cost of the vascular staplers also needs to be considered. Future trials with a randomized design and a longer period of follow-up are recommended before this technique can be accepted as a standard of care.

CONCLUSION

In conclusion, stapled SSCC is a safe, fast, and easily replicable technique with a short learning curve. The technique may be valuable to standardize the anastomosis, especially for difficult implantations.

ETHICS STATEMENT

The study was approved by the institutional review board and was registered with clinical trials registry of India (CTRI) (Ref/2019/09/028224). All procedures performed were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments.

CONFLICTS OF INTEREST

The authors have no conflicts to report.

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