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Case report

Outflow obstruction after living donor liver transplantation managed with a temporary vena cava filter: A case report

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ABSTRACT

Introduction: Outflow obstruction is a rare but critical vascular complication in liver transplantation, which may lead to graft loss and mortality. We report a case of caval vein outflow obstruction due to retrohepatic compression after living donor liver transplantation (LDLT), which was managed by temporary implantation of a vena cava filter.

Presentation of case: A 63-year-old male with end stage liver disease presented with caval vein outflow obstruction and massive ascites 12 days after right lobe LDLT. We opted for a minimally invasive approach and implanted a vena cava filter at the compressed site through transjugular route. The patient's ascites drainage significantly decreased and graft function maintained stable after the intervention. On day 50 posttransplant, the filter was successfully removed and the patient was discharged without complications.

Discussion: Outflow obstruction after liver transplantation can result from anastomotic stenosis, graft size mismatch, thrombosis or compression of the outflow tract. Various management strategies have been employed both peri- and posttransplant, ranging from surgical interventions to minimally-invasive techniques. The treatment strategy should be tailored to the individual case, considering the timing of presentation and the specific cause for the obstruction.

Conclusion: We successfully managed a case of compressive outflow obstruction by temporary implantation of a vena cava filter after LDLT. The vena cava filter was safely removed under angiography.

1. Introduction

Outflow obstruction, attributed to anastomotic stenosis or occlusion of the inferior vena cava (IVC), is a rare but serious vascular complication in liver transplantation. Posttransplant outflow obstruction is mostly caused by tight anastomosis, twisting of hepatic veins, or graft compression. This complication is associated with graft dysfunction and portal hypertension [1], and even graft loss if left untreated [2]. The possible treatment strategies include balloon angioplasty, placement of stent or inflatable materials placement, and in certain cases, retransplantation. In this report, we present a case of venous outflow obstruction caused by graft compression following living donor liver transplantation (LDLT), effectively managed by temporary implantation of a vena cava filter. Notably, this is the first report on using a vena cava filter to address this specific type of outflow obstruction. This case report has been reported in line with the SCARE criteria [3].

2. Presentation of case

The patient was a 63-year old male, diagnosed with end stage liver disease. The patient's functional independence was maintained with moderate assistance. He had a history of prolonged alcohol consumption, leading to alcoholic liver cirrhosis. Subsequently, he experienced esophageal varices bleeding, managed with endoscopic variceal ligation, and developed HCC in segment 7, treated with transarterial chemoembolization. Additionally, the patient had refractory ascites due to

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decompensated cirrhosis. By the time of LDLT, the patient has abstained from alcohol for one year. He received a right liver lobe from his son. The patient's model for end-stage liver disease-sodium (MELDNa) score was 17. The liver graft weighed 760 g, with a graft-to-recipient weight ratio (GRWR) of 1.06 %.

Following total hepatectomy, while preserving the retrohepatic vena cava, the right hepatic vein (RHV) of the right lobe liver graft was anastomosed to the recipient's RHV with extension on the IVC using continuous 5-0 polypropylene sutures. The portal vein reconstruction was performed by end-to-end anastomosis using 6-0 polypropylene sutures. The hepatic right lobe demonstrated excellent reperfusion after a warm ischemia time of 21 min. Subsequently, end-to-end anastomosis was performed between the right hepatic artery of the donor liver and the proper hepatic artery of the recipient using 8-0 polypropylene sutures. The bile duct anastomoses were completed with a Roux-en-Y hepaticojejunostomy using 7-0 PDS sutures.

During the first posttransplant week, daily measurements of ascites from percutaneous drainage tubes showed an increase from 900 mL to more than 2 L, which was resistant to diuretic treatment. In addition, the aspartate transaminase (AST), alanine aminotransferase (ALT), and total bilirubin (TBIL) levels increased to 282, 407 IU/mL, and 229μmol/L, respectively, two weeks after transplantation. Angiography showed a narrowing of the caval vein, while hepatic venography of RHV revealed no evidence of anastomotic stenosis (Fig. 1A). The intravascular pressures of the right atrium (RA), IVC, and RHV were 4, 15, and 26 mmHg, respectively. Subsequently, abdominal CT scans further confirmed the presence of retrohepatic narrowing, with a diameter measuring 7 mm. This constriction was caused by the liver graft compression (Fig. 1B). The patient's condition deteriorated, presenting with multiple complications, including acute kidney injury, massive ascites, and pleural effusion. On day 26 posttransplant, a vena cava filter (OptEase™, Cordis) was placed at the narrowing site through transjugular route (Fig. 2). This intervention immediately decreased the venous pressure gradient between RHV and RA from 15 mmHg to 2 mmHg (Table 1). Subsequently, the patient's liver function (AST and ALT) maintained stable, and TBIL decreased gradually to the normal range. The drainage of

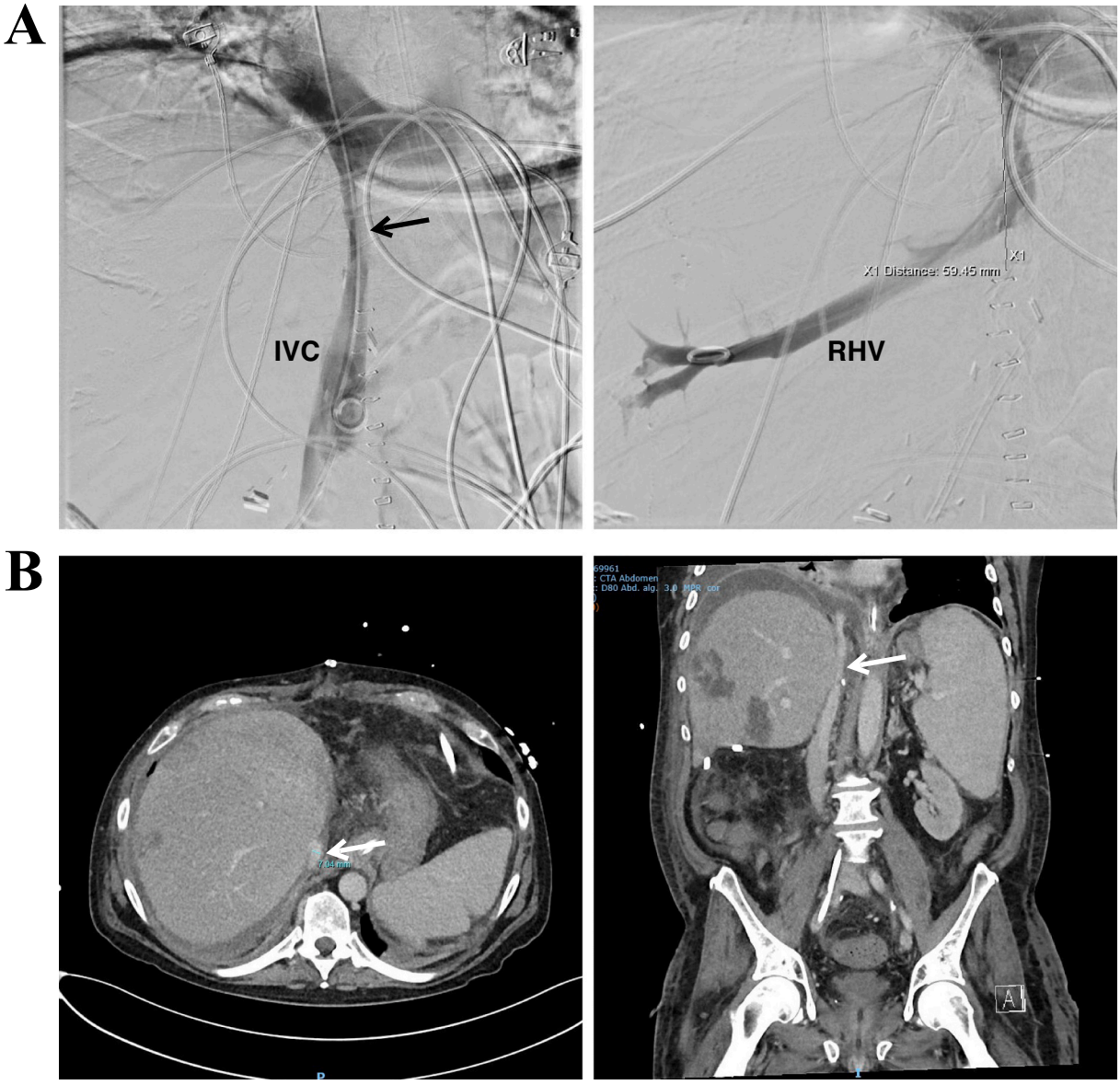

Fig. 1. (A) Venacavography shows inferior vena cava (IVC) obstruction (black arrow) with a 9 mmHg gradient between right hepatic vein and right atrium, and hepatic venography of the RHV reveals no evidence of stenosis or narrowing of the anastomosis. (B) Abdominal computed tomography shows the IVC obstruction (white arrow) due to the liver graft compression, with a diameter of 7 mm at the narrowing site.

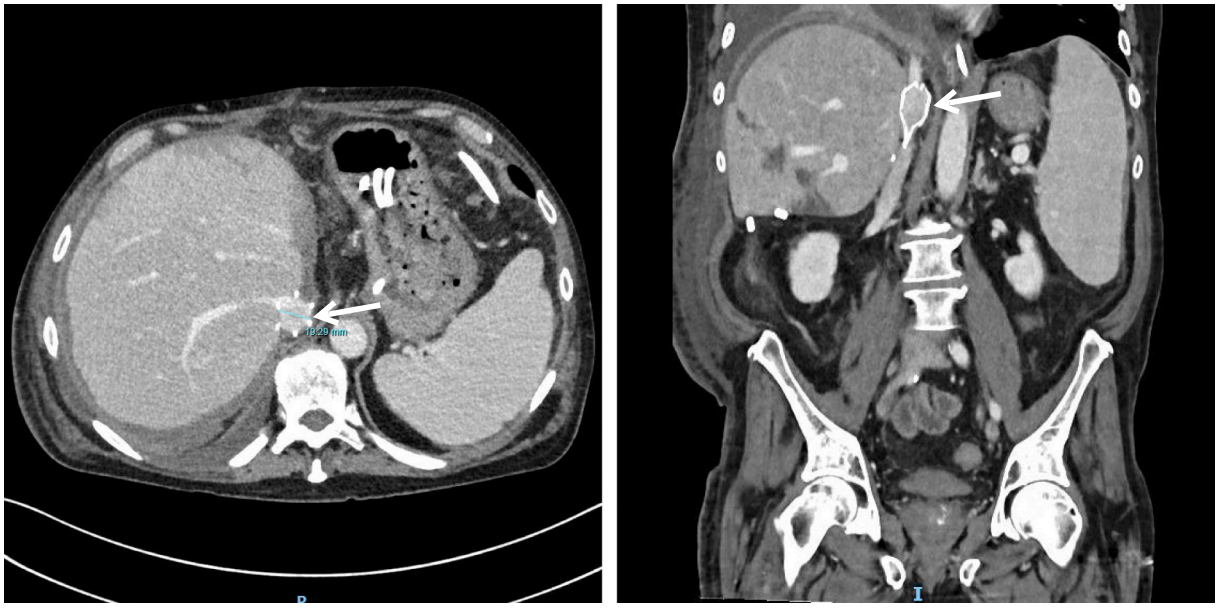

Fig. 2. Abdominal computed tomography shows the IVC obstruction was dilated by implanting a vena cava filter (white arrow), with a diameter of 19 mm after dilation.

Table 1
Measurement of the intravascular pressure before and after intervention.

	Before intervention (mmHg)	After intervention (mmHg)
RA	12 (19/3)	11 (17/7)
IVC narrowing	16 (21/10)	12 (16/9)
RHV	27 (32/25)	13 (18/11)

IVC, inferior vena cava; RA, right atrium; RHV, right hepatic vein.

ascites decreased to 100 mL on day 42 (Fig. 3), and the patient was discharged. On day 50 posttransplant, the vena cava filter was safely removed without recurrence of ascites. Follow-up doppler ultrasonography revealed good caval blood flow. Till the end of follow-up, the patient's condition remained favorable over 7 months after transplantation.

3. Discussion

Outflow obstruction occurs in both classic orthotopic liver transplantation and piggyback orthotopic liver transplantation. The reported incidence of outflow obstruction is 2 % using classic technique [4] and 3.5 %–4 % using piggyback technique [5,6]. Piggyback technique shows better haemodynamic stability, less blood product transfusion and shorter warm ischemia time [7,8]. However, outflow obstruction is the Achilles' heel of the piggyback technique, resulting from smaller anastomosis, kinking of the hepatic vein or retrohepatic compression of IVC by the liver graft. Patients experiencing outflow obstruction commonly present with congestive symptoms, including massive ascites, pleural effusion, elevated liver enzymes, and ultimately, graft failure. Diagnosis relies on a combination of clinical signs, radiological evaluation, and histopathological analysis. Among these diagnostic approaches, multidetector CT shows high sensitivity and specificity, and favorable spatial resolution [9,10]. While it may not be entirely preventable, the occurrence of outflow obstruction can be significantly reduced by an adequate anastomosis caliber, appropriate graft size, and closely monitoring for early congestive signs.

The management strategy for outflow obstruction varies across studies. Arudchelvam et al. [5] reported successful treatment of 19 cases of hepatic veinous obstruction using balloon angioplasty and stenting. Similarly, Mizuno et al. [11] managed IVC stenosis in two cases following right hepatic LDLT through the insertion of a Gianturco expandable metallic stent. Other innovative approaches include ectopic placement of a foley catheter, breast implants, or abdominal pads between the diaphragm and the graft to restore adequate hepatic venous outflow [12,13].

Based on the literature, the treatment strategy are individualized, considering the timing and specific cause for the obstruction. Balloon angioplasty and stent placement are minimally-invasive options, particularly suitable for addressing posttransplant stenosis without the need for reoperation. Moreover, their long-term safety and efficacy have been well established in previous studies [14,15]. However, it is essential to acknowledge potential drawbacks such as the risk of stents remaining permanently in the caval vein, complicating future venous reconstruction or retransplantation if needed. Balloon angioplasty also carries the risk of rupturing fresh anastomoses and may not effectively eliminate venous outflow abnormalities in the early posttransplant period [16]. In cases where outflow obstruction is identified peritransplant due to graft torsion or compression on the caval vein, the placement of inflatable materials between the diaphragm and the graft to adjust the liver graft's position extrahepatically can be a viable option. Whereas, if the obstruction is detected posttransplant, this approach can carry a higher risk of infection and morbidity due to the need for reoperation [17]. Additionally, the removal of such materials may require another invasive procedure.

In this case report, we present a novel approach of using a temporary vena cava filter to address outflow obstruction caused by liver graft compression. Primarily, vena cava filters have been used for the prevention of pulmonary embolism [18], with no prior studies reporting the application in resolving this specific issue. In our case, the vena cava filter's supportive structure was skillfully utilized upon deployment to alleviate the compression from the liver graft on the caval vein. The advantages of using a vena cava filter are remarkable. Firstly, the implantation process is under minimally invasive procedures, significantly reducing the risk of infection and mortality compared to open surgery [17]. Moreover, unlike stent placement, the vena cava filter can be removed without negatively affecting potential future liver transplant or other surgical procedures, providing flexibility for the patient's treatment options. Thirdly, the filter's original function in preventing blood clots resulting from hemodynamic instability further enhances its utility in this scenario. Therefore, in cases of compressive outflow obstruction,

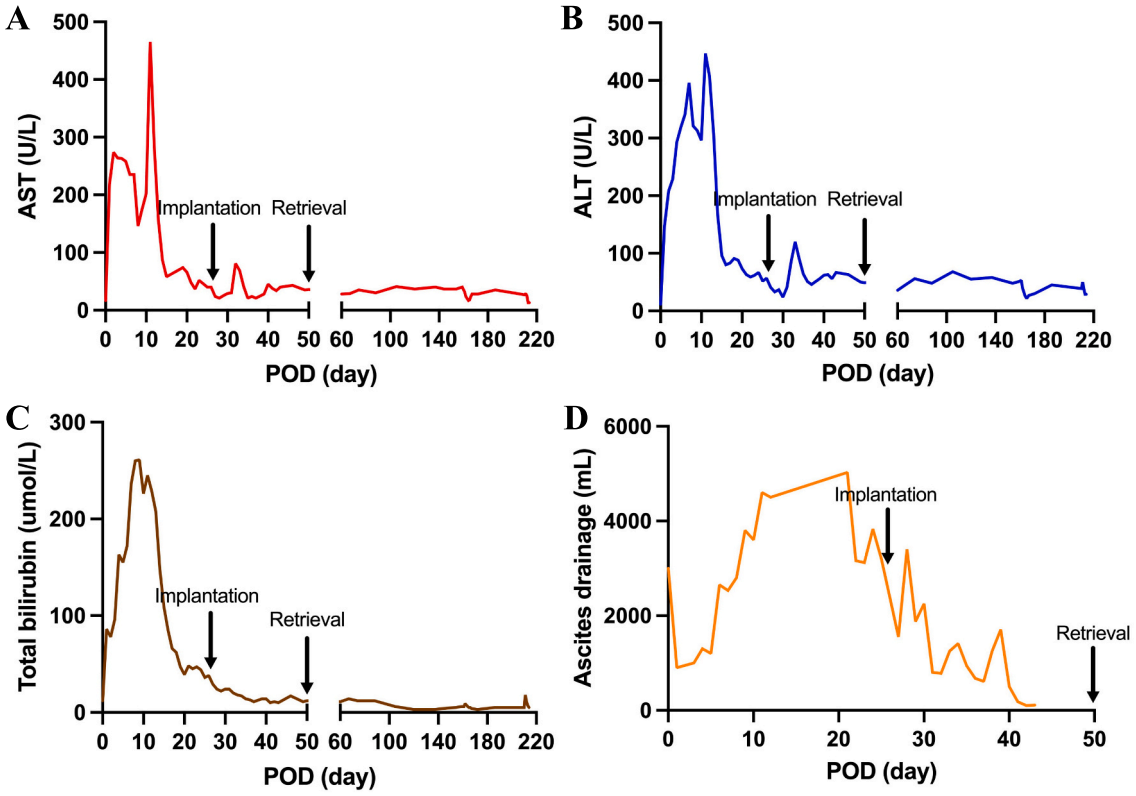

Fig. 3. Dynamic changes in liver function and ascites drainage, with the black arrows indicating the day of vena cava filter implantation and retrieval. AST, aspartate transaminase; ALT, alanine aminotransferase.

temporary implantation of filters owns its advantages and is worth being done more often. Nevertheless, it is essential to note potential complications. Firstly, like any invasive procedure, there is a risk of infection associated with vena cava filter implantation. Secondly, the filter may migrate from its initial placement site, leading to ineffective obstruction prevention. Thirdly, while one advantage of vena cava filters is their retrievability, retrieval difficulty is possible due to filter tilting, or ingrowth into the vena cava wall. The safety and effectiveness of the vena cava filter in resolving outflow obstruction require further validation through long-term follow-up and extensive clinical practice.

4. Conclusion

We present a successful case in which a vena cava filter was temporarily implanted to resolve caval vein outflow obstruction caused by graft compression following LDLT. The approach is minimally invasive, and the vena cava filter can be removed under angiography without interfering with potential future retransplantation.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Ethical approval

This case report is exempt from ethical approval in our institution for the following reasons:

1. Patient anonymity: The case report has been presented in a manner that ensures the complete anonymity and confidentiality of the patient involved. No personal or identifying information about the patient has been disclosed.
2. No experimental procedures: The case report does not involve any experimental procedures, interventions, or research activities that would necessitate ethical approval. It primarily describes a clinical case and the medical management provided to the patient.
3. Informed consent: Appropriate informed consent was obtained from the patient for the medical procedures and interventions described in the case report, as is customary in medical practice.

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Author contribution

F: Study concept and design, data collection, data interpretation, writing original draft.
AM: Reviewing and editing.
CH: Reviewing and editing.
RP: Reviewing and editing.
RM: Data interpretation, reviewing and editing.
MB: Data interpretation, reviewing and editing.

Guarantor

R. C. Minnee.

Research registration number

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Conflict of interest statement

The authors declare no conflicts of interest.

References

[1] Kumar A. Shalimar, S. Kedia, H. Sharma, S.R. Gamanagatti, G.S. Gulati, et al., Hepatic venous outflow tract obstruction: treatment outcomes and development of a new prognostic score, Aliment. Pharmacol. Ther. 43 (11) (2016) 1154–1167.

[2] P.J. Thuluvath, J.J. Alukal, T. Zhang, Acute liver failure in Budd-Chiari syndrome and a model to predict mortality, Hepatol. Int. 15 (1) (2021) 146–154.

[3] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, Group S, The SCARE 2020 guideline: updating consensus Surgical CAse REport (SCARE) guidelines, Int. J. Surg. 84 (2020) 226–230.

[4] U. Settmacher, N.C. Nussler, M. Glanemann, R. Haase, M. Heise, W.O. Bechstein, et al., Venous complications after orthotopic liver transplantation, Clin. Transpl. 14 (3) (2000) 235–241.

[5] J. Arudchelvam, A. Bartlett, J. McCall, P. Johnston, E. Gane, S. Munn, Hepatic venous outflow obstruction in piggyback liver transplantation: single centre experience, ANZ J. Surg. 87 (3) (2017) 182–185.

[6] S. Koc, S. Akbulut, V. Soyer, M. Yilmaz, B. Barut, R. Kutlu, et al., Hepatic venous outflow obstruction after living-donor liver transplant: single center experience, Exp. Clin. Transplant. 19 (8) (2021) 832–841.

[7] M. Hosein Shokouh-Amiri, A. Osama Gaber, W.A. Bagous, H.P. Grewal, D. K. Hathaway, S.R. Vera, et al., Choice of surgical technique influences perioperative outcomes in liver transplantation, Ann. Surg. 231 (6) (2000) 814–823.

[8] S. Khan, M.A. Silva, Y.M. Tan, A. John, B. Gunson, J.A. Buckels, et al., Conventional versus piggyback technique of caval implantation; without extra-corporeal veno-venous bypass. A comparative study, Transpl. Int. 19 (10) (2006) 795–801.

[9] M. Umehara, S. Narumi, M. Sugai, Y. Toyoki, K. Ishido, D. Kudo, et al., Hepatic venous outflow obstruction in living donor liver transplantation: balloon angioplasty or stent placement? Transplant. Proc. 44 (3) (2012) 769–771.

[10] U. Tannuri, A.C. Tannuri, M.M. Santos, H.T. Miyatani, Technique advance to avoid hepatic venous outflow obstruction in pediatric living-donor liver transplantation, Pediatr. Transplant. 19 (3) (2015) 261–266.

[11] S. Mizuno, H. Yokoi, K. Yamagiwa, M. Tabata, S. Isaji, K. Yamakado, et al., Outflow block secondary to stenosis of the inferior vena cava following living-donor liver transplantation? Clin. Transpl. 19 (2) (2005) 215–219.

[12] M.A. Wahab, A. Shehta, H. Hamed, M. Elshobary, T. Salah, A.M. Sultan, et al., Hepatic venous outflow obstruction after living donor liver transplantation managed with ectopic placement of a Foley catheter: a case report, Int. J. Surg. Case Rep. 10 (2015) 65–68.

[13] C. Lim, M. Osseis, A. Tudisco, E. Lahat, D. Sotirov, C. Salloum, et al., Hepatic venous outflow obstruction after whole liver transplantation of large-for-size graft: versatile intra-operative management, Ann. Hepatobiliary Pancreat. Surg. 22 (4) (2018) 321–325.

[14] R. Miraglia, A. Luca, G. Marrone, S. Caruso, D. Cintorino, M. Spada, et al., Percutaneous transhepatic venous angioplasty in a two-yr-old patient with hepatic vein stenosis after partial liver transplantation, Pediatr. Transplant. 11 (2) (2007) 222–224.

[15] G.Y. Ko, K.B. Sung, H.K. Yoon, K.R. Kim, J.H. Kim, D.I. Gwon, et al., Early posttransplant hepatic venous outflow obstruction: long-term efficacy of primary stent placement, Liver Transpl. 14 (10) (2008) 1505–1511.

[16] A.M. Rosales, J.E. Lock, S.B. Perry, R.L. Geggel, Interventional catheterization management of perioperative peripheral pulmonary stenosis: balloon angioplasty or endovascular stenting, Catheter. Cardiovasc. Interv. 56 (2) (2002) 272–277.

[17] Y. Kawaguchi, Y. Sugawara, N. Akamatsu, J. Kaneko, T. Hamada, T. Tanaka, et al., Impact of early reoperation following living-donor liver transplantation on graft survival, PLoS One 9 (11) (2014), e109731.

[18] T. Young, K.B. Sriram, Vena caval filters for the prevention of pulmonary embolism, Cochrane Database Syst. Rev. 10 (10) (2020), CD006212.