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What's new in the lower limit of GV & inflow modulation for SFS in LDLT

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Living-donor liver transplantation (LDLT) is an established lifesaving method for patients with end-stage liver disease (ESLD), but the absolute small size of partial grafts from living donors is a serious drawback compared to the whole liver from deceased donors. Accordingly, defining the lower limit of the partial graft weight (volume) is of utmost importance, not only to secure a satisfactory outcome for the recipient, but also to improve the safety of the donor. A small-for-size graft can enhance donor safety and may expand the donor pool, but it may also predispose recipients to small-for-size syndrome (SFSS), characterized by hyperbilirubinemia, coagulopathy, massive ascites, and in advanced stages, sepsis, encephalopathy and graft failure occurring early after liver transplantation. There are two major ways to describe the graft size in LDLT, which are widely used to discuss small-for size grafts and the lower limit of the graft: the graft-to-recipient weight ratio (GRWR) and the graft weight ratio to the standard liver volume (GW/SLV). According to the literature, the most common lower limit of partial grafts had been set to 0.8% for GRWR and 40% for GW/SLV, but many authors have reported the safety and possibility of smaller grafts than the aforementioned lower limits, and to date the lower limit of 0.7in GRWR and 35% in GW/SLV seems acceptable in experienced LDLT centers. Moreover, aggressive centers try even the graft of which 0.6 in GRWR or 30% in GW/SLV. Not only the size of the graft, but also other factors, such as recipient-related factors (disease severity and portal hypertension), graft-related factors (donor age, steatosis, ischemia times, ischemia/reperfusion injury, and immunological factors), and technical factors (vascular reconstruction and adequate outflow, vascular inflow, and pressure gradients) strongly affect recipient outcome after LDLT. Consequently, portal hyperperfusion syndrome or small-for-flow syndrome, rather than small-for-size, may more accurately describe the disease entity. In an effort to overcome this issue, various techniques for portal inflow modulation have been reported. Among those, simultaneous splenectomy has been the most popular and promising in decreasing the hyperportal flow. It was also indicated for HCV patients to facilitate IFN-based antiviral therapy prior to the advent of DAA, for ameliorating the thrombocytopenia, or for the immunomodulation among ABO-incompatible LDLT recipients. Nowadays the clinical benefit of simultaneous splenectomy in preventing

the development of SFSS and improving the graft survival is a matter of debate in the setting of LDLT. Another procedure affecting portal flow is ligating and dividing port-systemic shunts, which is preferably undergone along with splenectomy in centers favoring portal inflow modulation. Caution should be paid for these two techniques since they are conflicting in terms of portal hemodynamics. In our center, the lower limit of the estimated graft weight is set at 35% of estimated GW/SLV, and based on our previous studies showing disadvantageous effects of simultaneous splenectomy without improving graft survival, we have completely abandoned simultaneous splenectomy in 2015 and have never performed routine shunt ligation during LDLT, i.e. no portal modulation policy. In addition, we believe that making large outflow is more important for small-sized graft to protect against portal hyperflow, rather than inflow modulation, and have reported various techniques to secure the large hepatic venous orifice. Since 2015 till the end of 2022, totally 249 consecutive recipients with ESLD have undergone LDLT under no portal modulation policy, among those the incidence of the development of SFSS was 5.5% in GRWR ≥0.7 group and 4.2% in GRWR < 0.7 group, and 1,3, 5-year graft survival rate was 93%, 91%, 91% in GRWR ≥0.7 group and 92%, 92%, 89% in GRWR < 0.7 group, demonstrating that graft size itself does not affect the recipient outcome without intraoperative portal inflow modulation. Importantly, only 2 patients (0.8%) necessitated post-LDLT splenectomy to overcome long-lasting thrombocytopenia and refractory chronic rejection, respectively, and 6 patients (2.5%) required shunt embolization to restore the portal flow postoperatively.