Supplementary

The selection criteria for the value of *L*

According to the evaluation method of Murray's deviation based on the diameter method in previous studies (22,28), the diameters of 3–5 parent and daughter vessels near the vascular bifurcation point were selected to calculate Murray's deviation. Combined with the actual morphological structure of vascular bifurcation of rat liver based on the 9 μm resolution imaging we used in this study, if the measurement value of L is too small (<50 μm), it may cause some measurement error in the volume value of the selected vascular segment. In addition, the length of the sub-branches of some vessels was less than 150 μm. Based on the above conditions, L =100 μm was selected to ensure the applicability and accuracy of the assessment of bifurcation circulation in most vessels.

In addition, we further selected L = 75 μm and L = 125 μm, between 50 μm and 150 μm, to measure the Murray's deviation value of 20 randomly selected small vessel branches in the normal group and the severe fibrosis group based on the volume method. The results showed that the Murray's deviation values of the normal group and the severe fibrosis group were 1.04±0.20 and 1.75±0.58, respectively, when L = 75 μm. When L = 125 μm, the Murray's deviation values of the normal group and the severe fibrosis group were 1.05±0.15 and 1.71±0.38, respectively. Compared with the Murray's deviation value when L = 100 μm (1.02±0.24 in the normal group and 1.79±0.57 in the severe fibrosis group), the mean Murray's deviation value of both the normal group and the severe liver fibrosis group fluctuated within a reasonable range of 5%. Therefore, the selection of L = 100 μm can ensure the applicability and accuracy of the measurement results.

For different animal models and disease stages, the L value should be determined within a reasonable range according to the actual situation under the following conditions. First, in a specific disease model, the maximum and minimum values of L and their distribution rules are determined so as to obtain its approximate range. Second, according to the actual situation such as image quality and resolution, a more accurate range of L is determined under the condition that as much measurement data as possible can be obtained to ensure the accuracy of the results. Finally, the specific L value is selected and its upper and lower interval values within the reasonable range obtained in Step 2 are verified to ensure the accuracy and universality of the selected specific L value.

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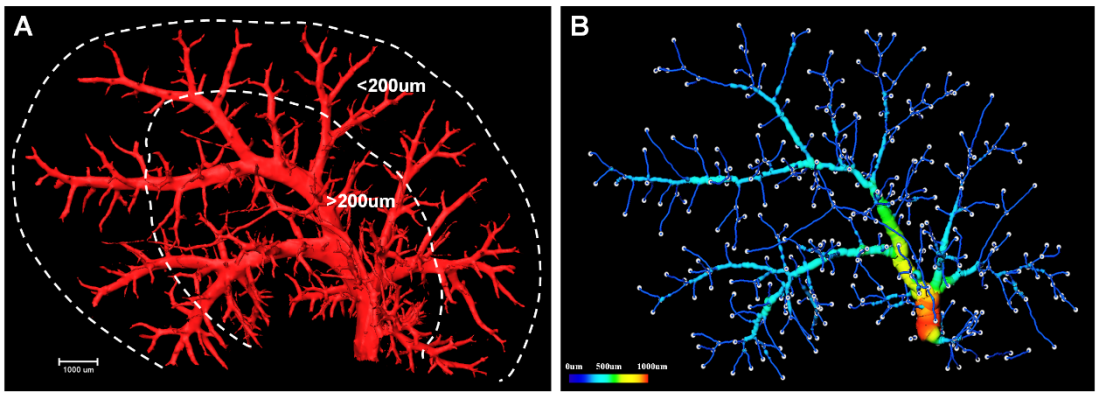

Figure S1 Schematic diagram of the distribution of the main and small vessels in the vascular system. (A) A 3-dimentional (3D) surface reconstruction of the intrahepatic vascular tree. The area within the white dotted lines represent small blood vessels (< 200 μm) and the remaining area represent main blood vessels (diameter ≥ 200 μm). (B) The 3D centerline extracted from the vascular system in (A). The color coding reflects the vessel thickness.

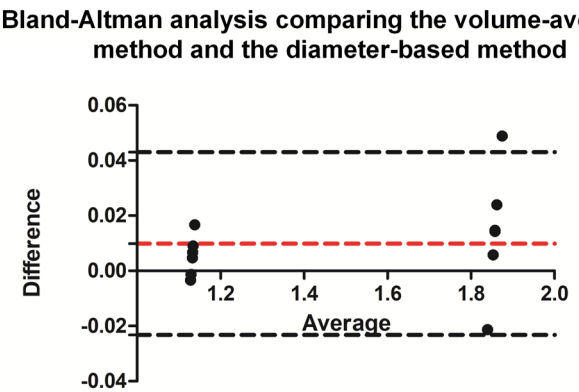

Figure S2 Bland-Altman analysis showed good agreement between the volume-averaged method and the diameter-based method.

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Table S1 Components and parameters of the phase-contrast computed tomography (PCCT) setup

Experimental parameter	9-μm resolution
X-ray source	Synchrotron radiation
Photon energy	24 Kev
Field of view	36 mm (horizontal) × 5 mm (vertical)
Matrix size	4008×2672 pixels
Monochromator	Si(111) double-crystal
CCD (charge-coupled device) detector	X-ray Imager-VHR1:1; Photonic Science, Britain
Sample-to-detector distance	1.2 m
Projection images	600
Exposure time per projection	12 ms
Computed tomography scan time per specimen	8 min
Dark-field images	10
Flat-field images	20

Additional details of the imaging system are available from BL13W1 X-ray Imaging and Biomedical Applications Beamline (http://e-ssrf.sinap.cas.cn/beamlines/bl13w1/201401/t20140112_152430.html).

Table S2 The measurement parameters and times of the diameter-based method and the volume-averaged method

Group	Animal	Main vessel	Small vessel	D_0 /D_1 /D_2	Volume
Normal	n=6	n=20	n=20	n=40 /40 /40	n=40
Moderate	n=6	n=20	n=20	n=40 /40 /40	n=40
Severe	n=6	n=20	n=20	n=40 /40 /40	n=40
Regressive	n=6	n=20	n=20	n=40 /40 /40	n=40

n, number; D_0, the diameter of the parent vessel; D_1 and D_2, the diameters of the daughter blood vessels.

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