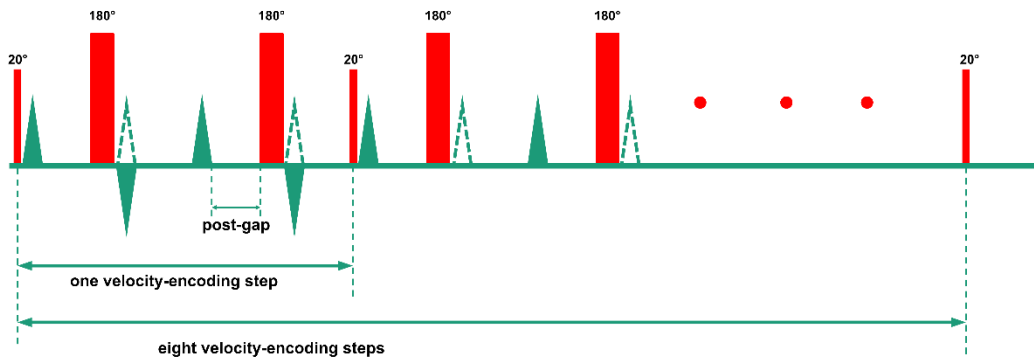


Supporting Information Figure S1: The sequence diagram of the 64 ms FT-VSI pulse train: it is composed of nine excitation pulses (20° hard pulses) with eight velocity-encoding steps, with each step (8 ms) interleaved with paired and phase-cycled refocusing pulses and four triangular gradient lobes with alternating polarity (21.8 mT/m, 0.6 ms duration, 0.3 ms ramp time, 2.8 cm/s cut-off velocity). The duration of block (180°_y) and composite ($90^\circ_x 180^\circ_y 90^\circ_x$) refocusing pulses are 0.5 and 1.0 ms, with post-gaps following gradient lobes of 1.02 and 0.77 ms, respectively.



Supporting Information Figure S2: Quantitative CBF maps (one slice) derived from FT-VSI prepared VSASL applying block (first row) and composite (second row) refocusing pulses on a young male subject (left column) and a middle-aged female subject (right column). Abnormal perfusion signal can be observed in the anterior brain regions (marked by red arrows) for block refocusing pulses but is suppressed when composite refocusing pulses were used. This is consistent with the eddy-current effect under poor B1 offset as demonstrated in the numerical simulation results (Figure 2) and phantom results (Figure 3).

