Comparison of cerebral blood flow (CBF) data obtained by perfusion CT (PCT) with that obtained by xenon CT (XeCT) using 320-row CT and automated region of interest (ROI) determining software

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Background: Cerebral blood flow (CBF) data obtained by computed tomography perfusion (CTP) imaging has been shown to be qualitative data rather than quantitative, in contrast with data obtained by other imaging methods, such as xenon CT (XeCT) imaging. Thus, inter-patient comparisons of CBF values obtained by CTP may be inaccurate. In this study, we have compared CBF ratios as well as CBF values obtained from CTP-CBF data to those obtained from XeCT-CBF data for the same patients to determine CTP-CBF parameters that can be used for inter-patient comparisons.

Methods: We reviewed ten patients with occlusive cerebrovascular diseases (CVD) undergoing both CTP and XeCT in the same period (Summarized in Table 1). Both CTP-CBF and XeCT-CBF were obtained as volume data using 320-row CT. The data were analysed by automated region-of-interest (ROI)-determining software (3DSRT) for more objective evaluation. CBF in the region of the MCA (CBF-MCA), CBF in the region of the lenticular nucleus (CBF-LN), the haemodynamic stress distribution (hdSD; ratio of CBF-LN to CBF-MCA), the left/right ratio of CBF-MCA, and the left/right ratio of CBF-LN were calculated. Pearson's correlation coefficient was calculated and simple regression analyses were used to assess the relations between data obtained by CTP and by XeCT.

Results: CTP studies and XeCT studies were performed with no complications for any patient. Data were analysed off-line using 3DSRT software. Automated determination of supratentorial ROIs was successfully accomplished for each image (fig. 1). Of five parameters evaluated, statistically significant correlations were observed between data of both imaging modalities for both hdSD (p=0.0154, r=0.5336) and the CBF-MCA left/right ratio (p=0.0274, r=0.6893). (definition of hdSD in this study is presented in fig. 2). The regression line using hdSD obtained by XeCT as outcome variable (y) and hdSD obtained by CTP as predictor variable (x) was y=0.8856x-0.1093, and the regression line using the left/right ratio of MCA-CBF obtained by XeCT as outcome variable (y) and that obtained by CTP as predictor variable (x) was y=2.347x-1.258 (fig. 3).

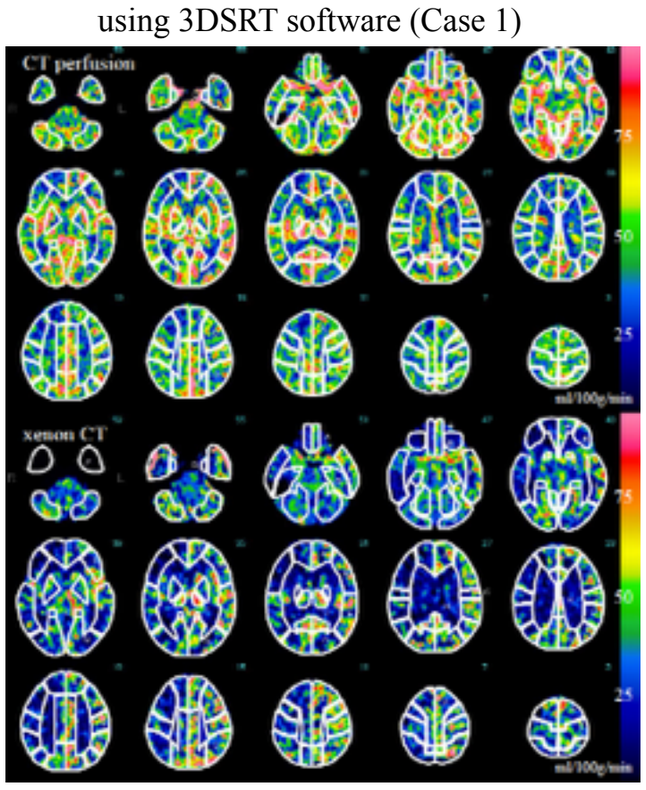
Conclusions: In the present study, the CBF value itself obtained from CTP has been shown to not correlate with the CBF value obtained from XeCT and, thus, is not suitable for inter-patient comparisons among patients with occlusive cerebrovascular diseases. By contrast, ratios of CBF measurements, such as hdSD or the left/right ratio for the region of the MCA, calculated using CT perfusion data have been shown to correlate well with the same ratios calculated using XeCT data. These results suggest that such CBF ratios could be useful for generating inter-patient comparisons of CTP-CBF among patients with occlusive CVD.

Table 1 Patients' characteristics

Case	Age, Sex	Disease	Stesosis side
1	31, F	Moyamoya Disease	Bil
2	39, F	Rt IC stenosis	Rt
3	68, F	Lt IC occulusion	Lt
4	59, M	Lt Cervical IC	Lt
5	82, M	Lt IC stenosis	Lt
6	80, M	Lt IC stenosis	Lt
7	69, M	Lt IC stenosis	Lt
8	73, M	Rt IC stenosis	Bil
9	61, F	Moyamoya Disease	Rt
10	63, M	Rt IC stenosis	Rt

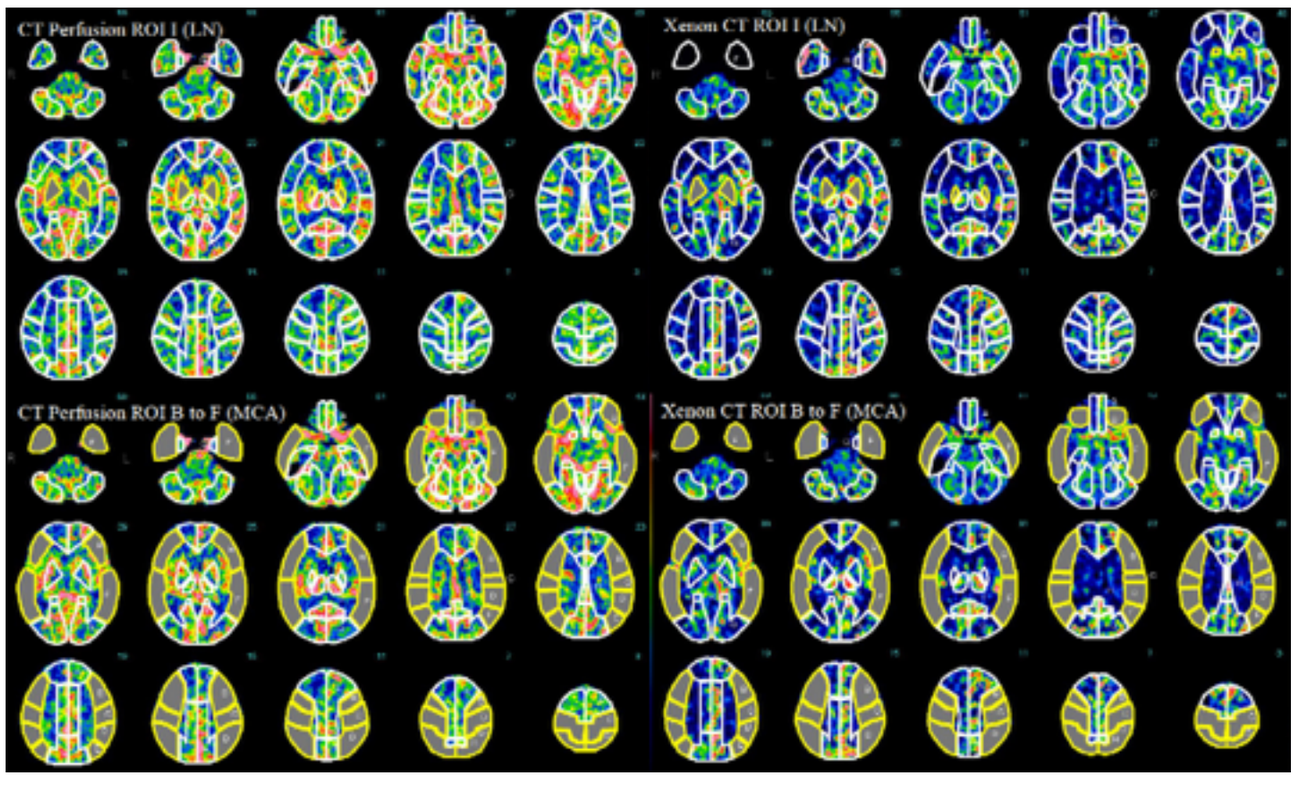
We retrospectively analyzed 10 adult patients with documented occlusive CVD seen at Institute of Brain and Blood Vessels, Mihara Memorial Hospital, Isesaki, Gunma, Japan in 2012 and 2013 for further workup. The patients comprised 4 males and 6 females. The mean age was 62.5 years (range, 31–82 years).

Figure 1.
Automated determination of ROI using 3DSRT software (Case 1)



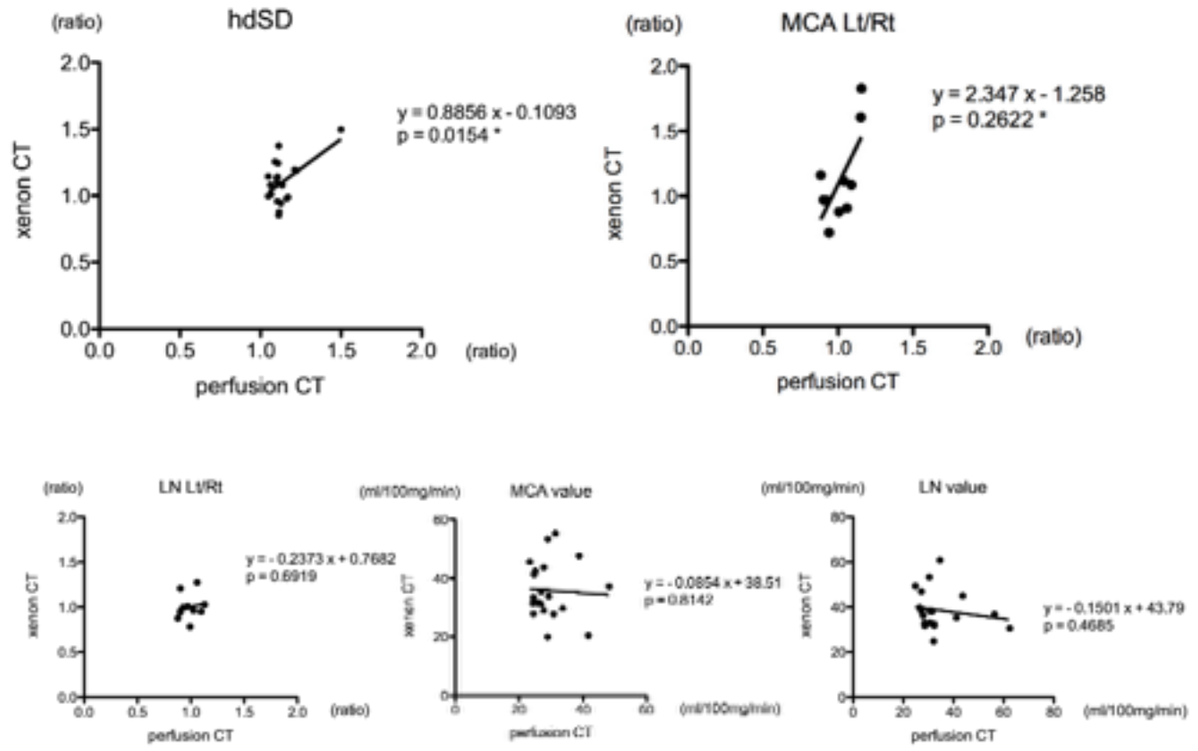
upper: CT perfusion data, lower: Xenon CT data

Figure 2.
Definition of hdSD in the present study (Case 1)



upper: ROI I; stands for lenticular nucleus, lower: ROI B to F; stands for MCA.
left: CT perfusion data, right: xenon CT data
hdSD: (average value for ROI I (lenticular nucleus))/(average value for ROI B to F (MCA)

Figure 3.
Regression analyses to assess the relations between data obtained by CTP and by XeCT



Of five parameters evaluated, statistically significant correlations were observed between data of both imaging modalities for both hdSD and the CBF-MCA left/right ratio.