

The Study of Cerebral Blood Flow Variations Following Radiation Dose Gradients for Brain Metastasis Patients During Radiotherapy

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Abstract

Background: Changes of cerebral blood flow in different brain regions of patients with brain metastases after radiotherapy are worth exploring. This study aims to investigate the radiation dose range of normal brain tissue and tumor target area by evaluating the cerebral blood flow (CBF) for brain metastases (BMs) patients applying with 3D arterial spin labeling (ASL).

Methods: A total of 26 patients harboring 54 BMs treated with radiotherapy (RT) were imaged with magnetic resonance (MR) before and 30-40Gy post RT. The high signal area of BMs on enhanced T1-weighted images (T1WI), normal brain tissue, and peritumoral edema region were defined as regions of interest (ROIs). Changes and correlation of largest cross-sectional area and maximum CBF in BMs before and after RT were analyzed. Maximum CBF change in the three ROIs under different gradients created by thresholding the individual dose maps at 10 Gy steps were assessed.

Results: In terms of 54 BMs, a significant decrease of CBF of 29.64% ($P < 0.05$) compared to largest cross-sectional area of 26.46% ($P < 0.05$). The decrease of CBF was more pronounced for 30-40 Gy (33.75%) than for 40-50Gy and >50Gy (24.61% and 27.55%). In normal brain tissue with dose gradients of 30-40Gy, CBF decreased to the maximum, 20.23% ($P < 0.05$), which was similar to BMs. In contrast, the decrement rate of CBF in the peritumoral edema region increased as the dose gradients increased.

Conclusions: CBF decreased significantly during the course of RT. According to CBF variations, the dose to the normal brain tissue should be controlled below 30 Gy as much as possible, whereas tumor with high perfusion and peritumoral edema region should be given a higher dose.

Full Text

This preprint is available for [download as a PDF](#).

Figures

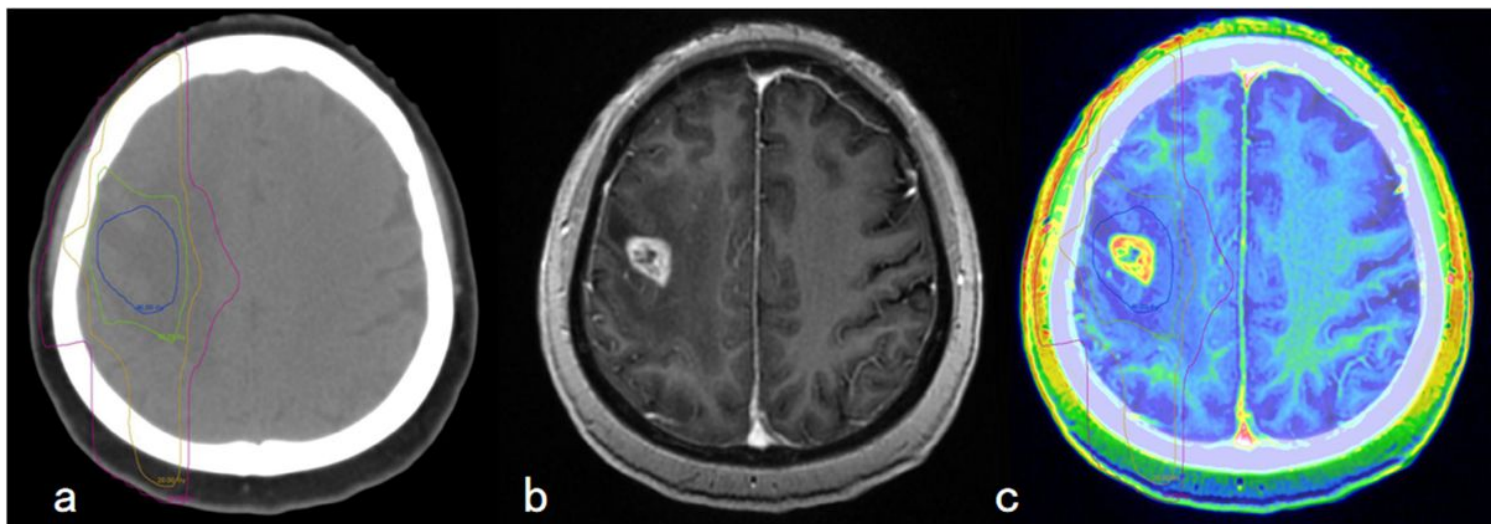


Figure 1

A 46-year old female patient with primary lung cancer received 40 Gy radiotherapy. The radiation-dose map was categorized into 0-10, 10-20, 20-30, 30-40 and >40 Gy. a:Dose distribution map of RT plan; b: Enhanced T1 WI image before radiotherapy; c: Fusion registration image;

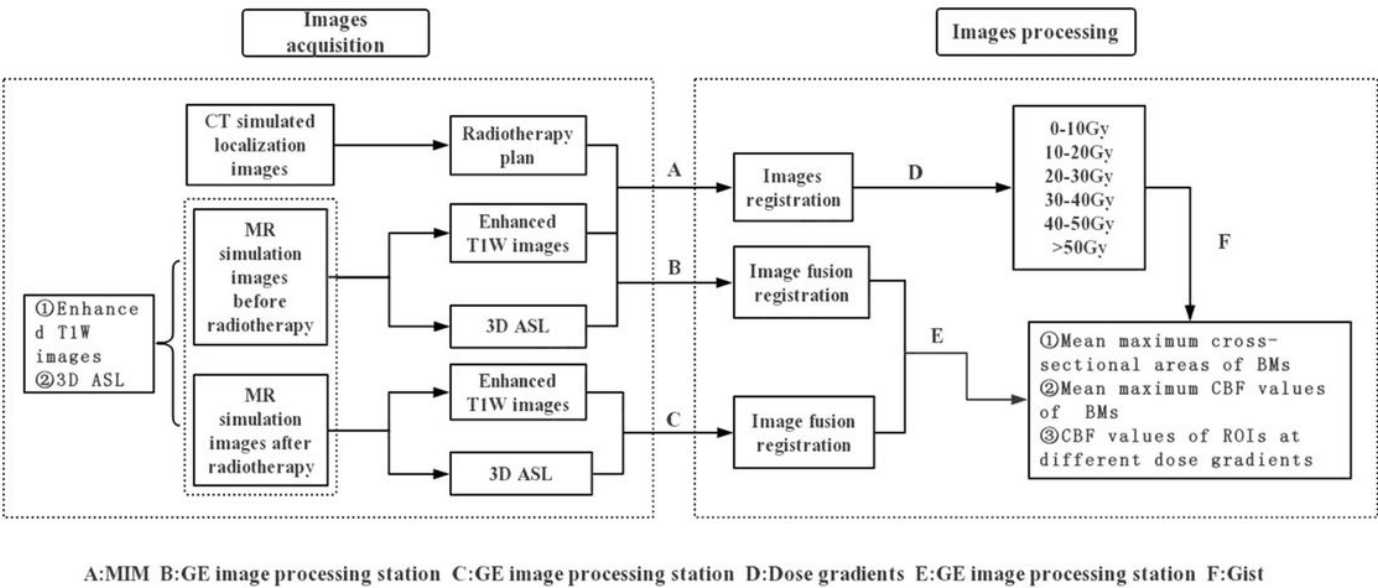
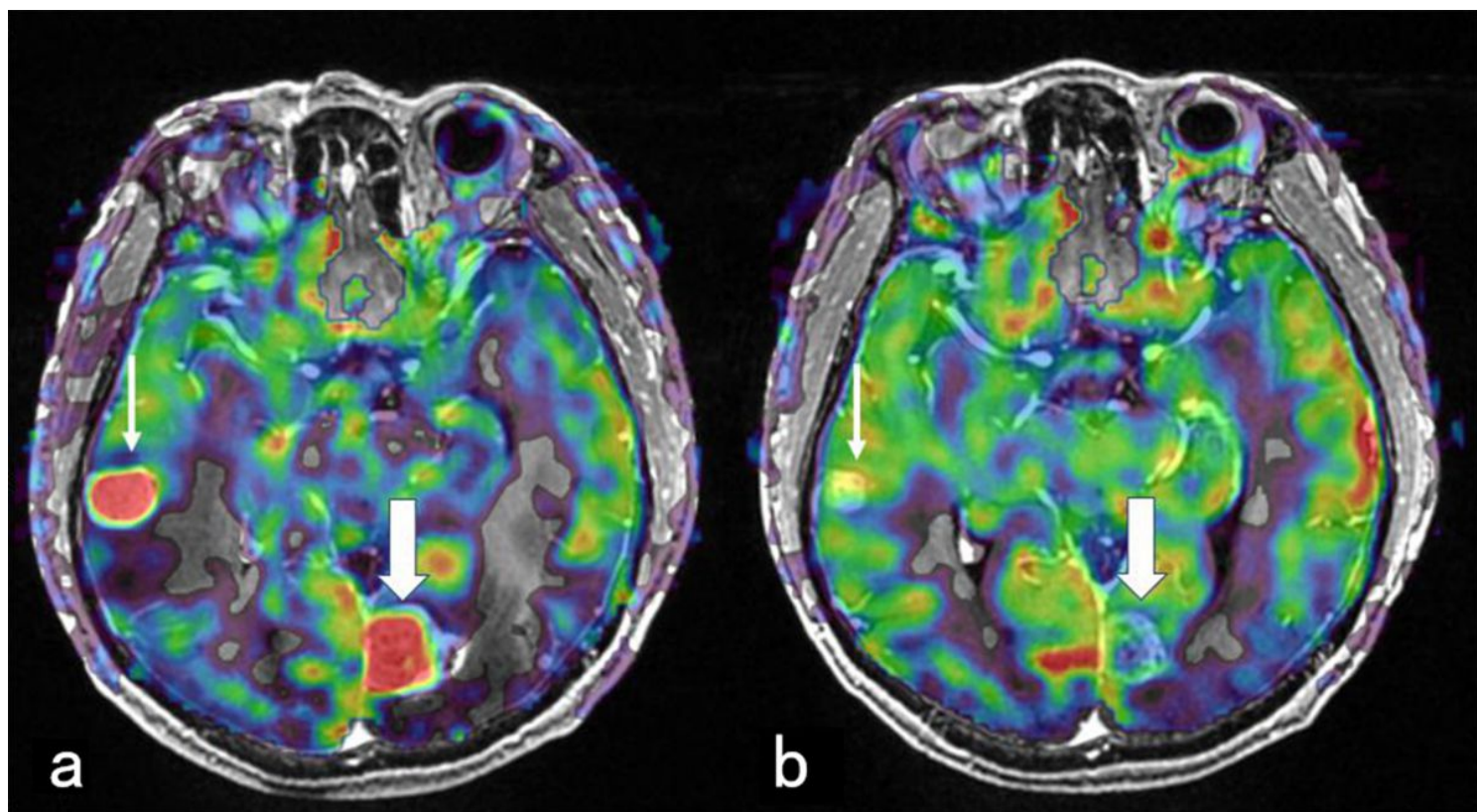


Figure 2

Working flow Chart



($\Downarrow$:Tumor 1 $\Downarrow$:Tumor 2)

Figure 3

A45-year-old woman with BMs of lung cancer received radiotherapy

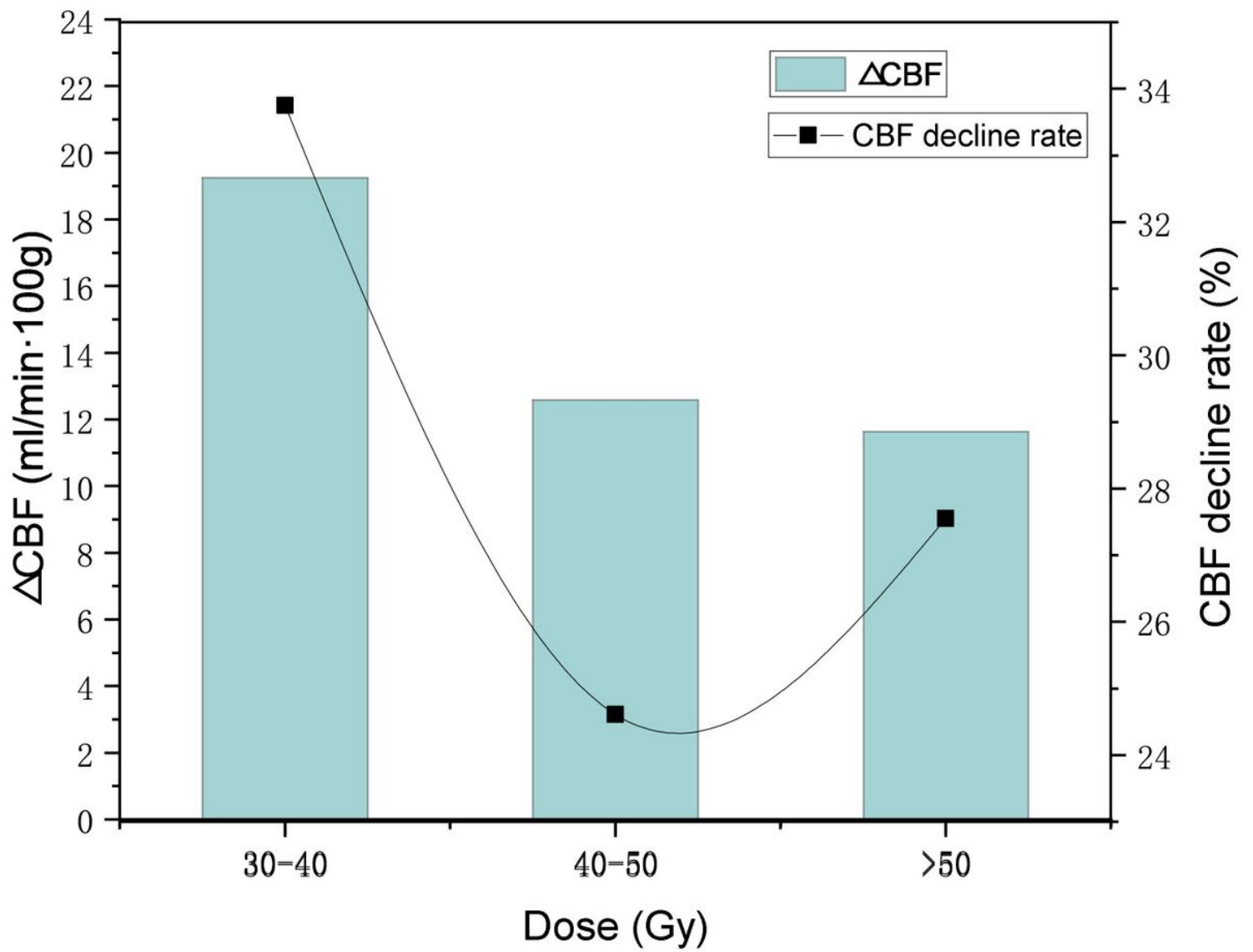


Figure 4

Perfusion changes of BMs

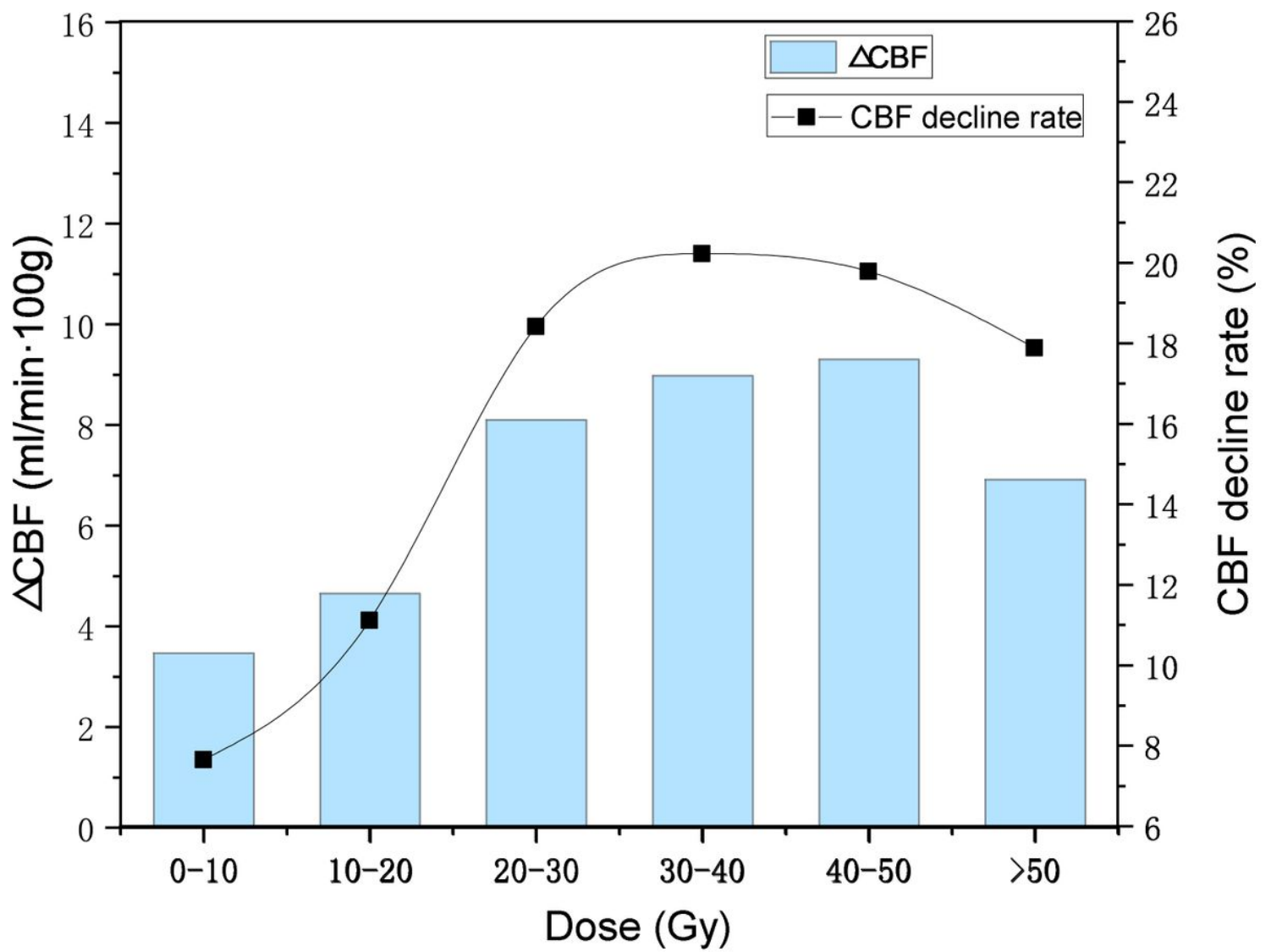


Figure 5

Perfusion changes of normal brain tissue.

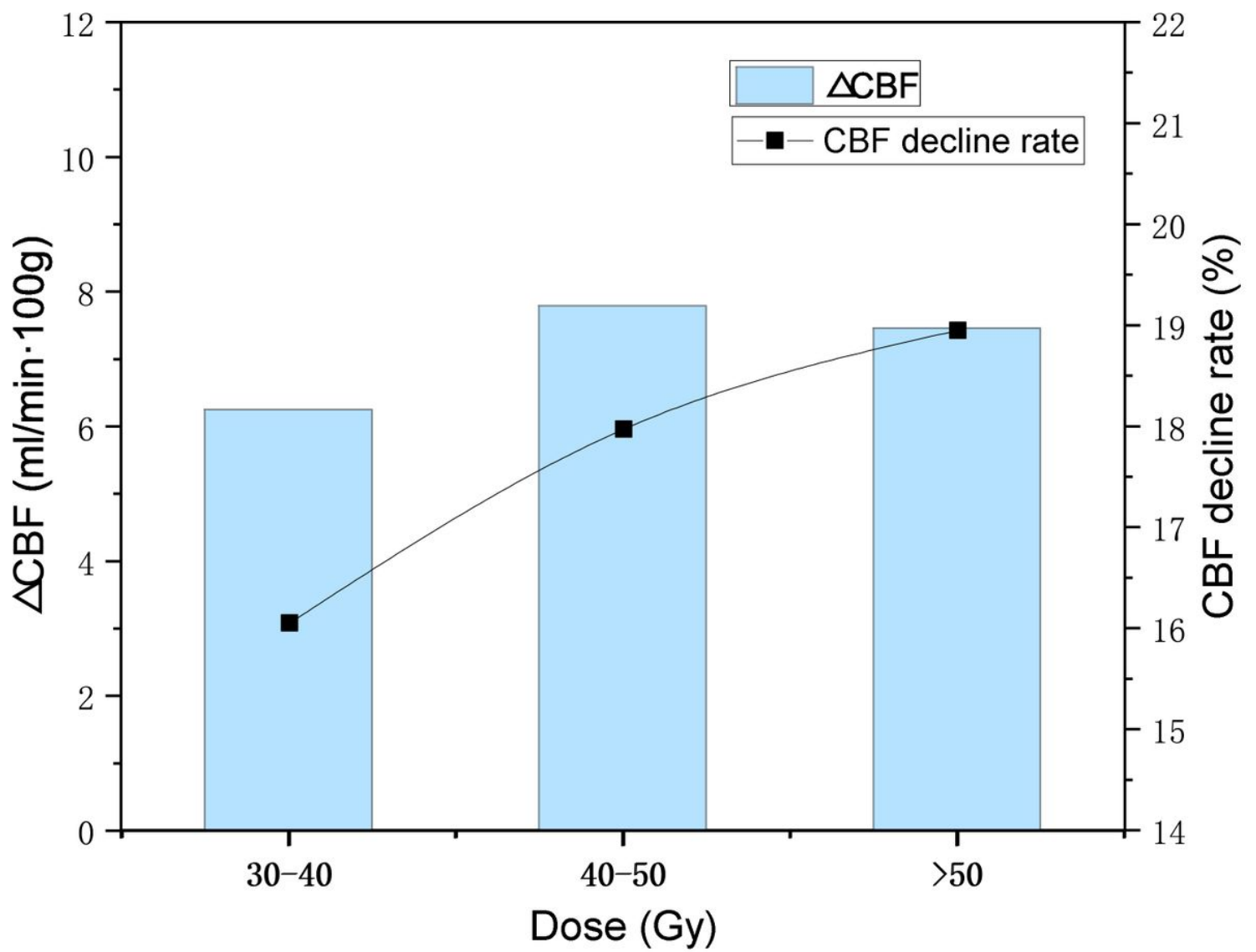


Figure 6

Perfusion changes of peritumoral edema region.