BACKGROUND: Deconvolution methods used to quantify brain perfusion parameters fail to optimally quantify cerebral blood flow (CBF), mean transit time (MTT) and arterial-tissue delay (ATD). The Bayesian method (1) is a rigorous probabilistic estimation of hemodynamic parameters. From a quantitative point of view, this method outperforms deconvolution methods (standard, block-circulant or oscillating Singular Value Deconvolution (SVD)), especially at low SNR (1). This performance improvement is paramount for the post-processing of CT perfusion images for an optimal diagnostic imaging during the hyperacute phase of stroke.

METHOD: CT perfusion native images from hyperacute ischemic stroke patients were post-processed using a development version of OleaSphere™ (Olea Medical, La Ciotat, France). The estimation of Tmax was performed using a deconvolution method to determine the area at risk of necrosis (cSVD Tmax threshold=6 sec., red color on Tmax map) colored in blue on the predictive map. The Bayesian Method was used to optimally quantify other hemodynamic parameters (TTP, MTT, CBF, CBV, ATD) to determine the area already necrosed (Absolute CBF value<10 ml/100g/mn) colored in red on the predictive map. The reperfusion was checked 24 hours after stroke onset by means of a new CT perfusion exam. Two cases of stroke are presented: one with complete reperfusion at 24h (figure 1), the other without reperfusion at 24h (figure 2). The final infarct volume was determined from a non contrast CT performed 3 months after stroke onset.

RESULTS: In patient 1, follow-up images demonstrate that most of the blue « penumbral » area delineated on the predictive map was preserved from necrosis thanks to the early reperfusion while the red « core » area delineated on the predictive map well corresponds to the final infarct volume. In patient 2, the follow-up images demonstrate that most of the blue « penumbral » area delineated on the predictive map well corresponds to the final infarct volume in relation with the absence of reperfusion. Interestingly, in both cases, the area with the most severe collateral circulation deficiency (red color on ATD map) seems tightly correlated with the final infarct volume.

CONCLUSIONS: By comparison with deconvolution methods the Bayesian estimation of hemodynamic parameters significantly increases the informational content of CT perfusion images. The accuracy of the Bayesian quantification might improve the selection of acute ischemic stroke patients for thrombolysis based CT perfusion.

REFERENCES: