Whole-brain CTP in acute ischemic stroke

by

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PhD studying has never been an easy ride. Luckily, I have the most wonderful supervisors guiding me through ups and downs during the way. Therefore, I would like to pay my sincere thanks to my supervisors, Professor Mark Parsons and Professor Christopher Levi. Thank you, Mark, for sharing your precious time and knowledge with me. I have enjoyed very much our weekly meeting discussing new research ideas. Thank you, Chris, for helping me to stand on my own feet when I first came to Australia. For both my supervisors, your intelligence amazes me, your work ethic inspires me, and your charming personality makes it so easy to work for you.

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DECLARATION

I Longting Lin hereby declare that the thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

I Longting Lin hereby certify that this thesis is in the form of a series of published papers of which I am a joint author. I have included as part of the thesis a written statement from each co-author, endorsed by the Faculty Assistant Dean (Research Training), attesting to my contribution to the joint publications.

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PUBLICATIONS, PRESENTATION, AND AWARDS

*Peer reviewed publications included in this thesis:


- Lin L, Bivard A, Krishnamurthy V, Levi CR, Parsons MW. Whole-brain CT perfusion measures the acute infarct core and penumbra accurately and precisely (Submitted to Radiology, RAD-15-0319)

- Lin L, Bivard A, Levi CR, Parsons MW. Reperfusion on Tmax Map Best Predicts Clinical Outcome of Stroke (submitted)
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Other publications and conference presentations:


Statement by co-authors for the paper:


As co-authors of the paper, we confirm that Longting Lin is the primary contributor to the publication. Longting Lin has made following contributions:

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ABSTRACT

Perfusion imaging technology not only enables stroke diagnosis by identifying the ischemic lesion earlier, but also helps the clinician to make treatment decisions by further classifying the ischemic lesion into salvageable tissue and non-salvageable tissue. The imaging of salvageable tissue, penumbra, provides a direct target for reperfusion treatment. However, the accuracy of penumbra measurement with perfusion imaging has been questioned, especially with CT perfusion (CTP). Perfusion images, acquired on earlier generation instruments such as the 16 or 64-detector scanners, have limited coverage of potentially ischemic brain, a factor recognised to reduce the accuracy of penumbra measurement. This limitation can be overcome by the advance in technology. The new generation “mega-detector” scanners, such as 320-detector Toshiba Aquilion One, provide whole brain coverage of 160mm from skull base to vertex. In this thesis, I presented a series of studies aiming to evaluate the utility of whole-brain CTP in acute ischemic stroke.

The first study was to derive the optimal penumbra measurement on whole-brain CTP with the reference of ischemic tissue outcome, and the second study was to test the penumbra measurement of whole-brain CTP in predicting clinical patient outcome. The two studies found that only with the threshold setting at Tmax>6s or DT>3s, did the whole-brain CTP achieve high accuracy (>99%) in delineating acute ischemic penumbra and good sensitivity (>80%) in predicting favourable clinical outcome. It was also confirmed that the accuracy of penumbra measurement was comprised when the brain coverage of CTP decreased from 160mm to 20mm.

Following two studies examined the utility of whole-brain CTP in the clinical setting. Firstly, CTP was compared to MRP, the perfusion modality that has already been well used in clinic. This work demonstrated that with whole brain coverage, CTP was as effective as MPR in
measuring the acute penumbra and in selecting patients for reperfusion treatment. Secondly, a case by case review was carried out to assist clinicians in the interpretation CTP output.

In conclusion, findings of this thesis support the usage of whole-brain CTP in acute ischemic stroke. Noticeably, the conclusion only applies to patients with anterior circulation stroke. Whole-brain CTP might also have advantage in detecting ischemic lesions in posterior circulation territory, which require studies to prove it in the future.