Wake-up stroke and CT perfusion: an innovative therapeutic possibility. The experience of Stroke Unit of Trieste

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Background

Wake-up stroke (WUS) represents roughly 1 in 5 acute ischemic strokes and remains a therapeutic dilemma. Because of the unknown time onset of the stroke, these patients are usually excluded from acute reperfusion therapy in clinical practice due to high IVT related bleeding risk. Over the years several neuroimaging methods have been adopted to predict which patients may develop reperfusion-related hemorrhage after revascularization. Infarct size and unknown stroke onset are the most established risk factors. Perfusion imaging can be useful to assess the risk in WUS. For a given large volume of infarct (100ml), perfusion weighted MRI and CT may suggest high risk of hemorrhagic complication if Tmax is delayed at least 8 seconds or if the mean CBV is less than 1.8 ml/100g, respectively. Therefore the central task of perfusion imaging is to discriminate infarcted core from the ischemic penumbra. Literature shows that thanks to emerging neuroimaging techniques, some WUS patients may be eligible for thrombolysis, leading to better clinical outcomes in treated WUS patients compared to non-treated WUS patients.

Methodology: CT perfusion

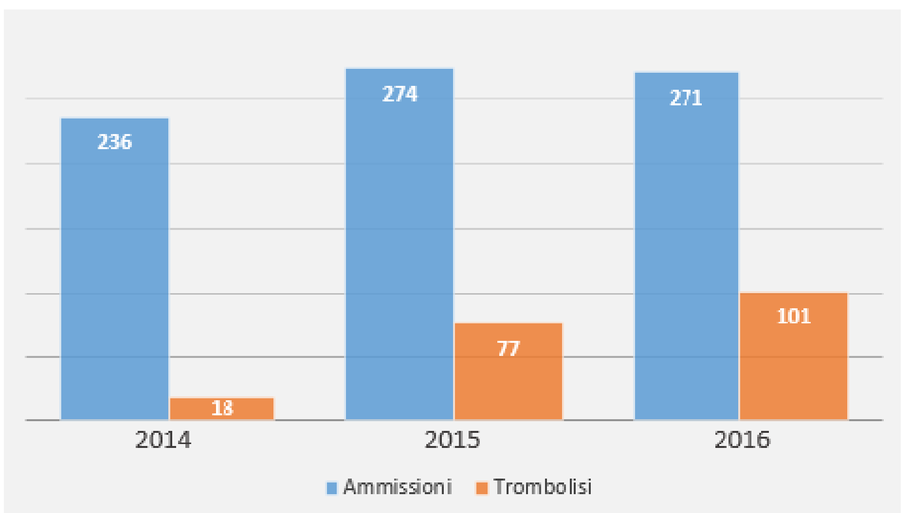
CT perfusion repeatedly scans the same area of the brain while a contrast medium runs from the arteries through the capillaries to the veins. Through a software, colour maps are generated:

- Time to peak (TTP) shows the time for the contrast medium to reach the tissue. It is the most sensitive marker for cerebral ischaemia. Ischaemic area show higher TTP, as the contrast medium takes more time to reach them compared to non-ischaemic tissues. Alternatively, mean transit time (MTT) or time to maximum (Tmax) can be calculated. Both are higher in an ischaemic area.
- Cerebral blood volume (CBV) refers to the volume of blood present at a given moment in a specific brain area.
- Cerebral blood flow (CBF) is the blood supply to the brain at a given time in a specific brain area.

The aim of CT perfusion is to discriminate the infarct core (irreversibly damaged brain tissue) from penumbra (brain tissue at risk of irreversibe damage). There are different approaches for estimating the penumbra in CT perfusion. Areas with significantly low CBV represent the ischaemic core, meanwhile areas with normal CBV and reduced CBF and/or TTP are the penumbra. The mismatch between CBV and CBF maps represents the penumbral area. According to other studies, a CBF level 30%–50% lower compared to mean CBF in the contralateral hemisphere is more reliable to predict infarct core.

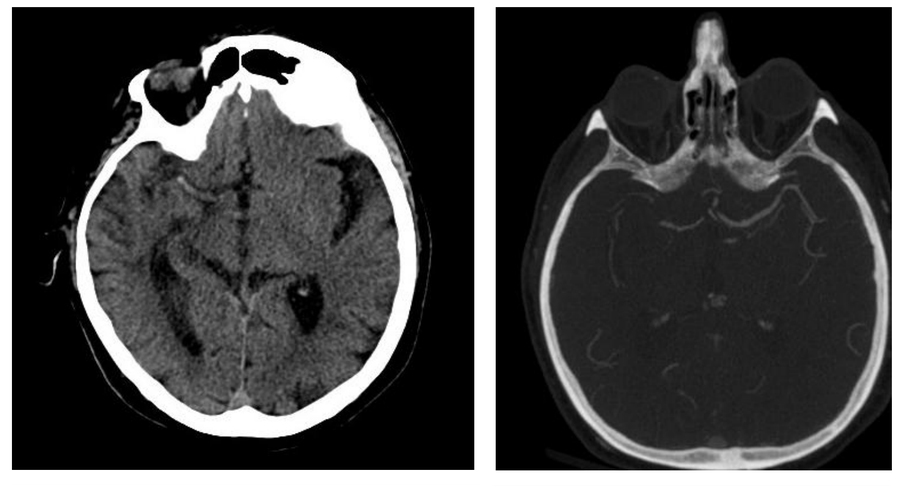
Our Experience

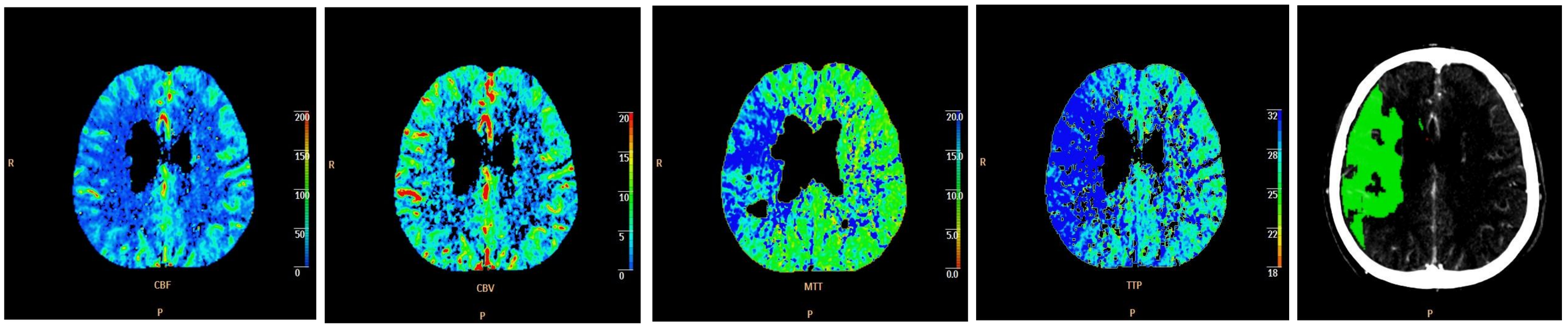
In 2014 our stroke unit admitted 236 patients, 18 of which were treated with thrombolytic therapy. In 2015 the admitted patients were 274, 77 of which received thrombolytic therapy. Since no CT perfusion technique was available, in 2014 and 2015 no wake-up stroke patient was treated with thrombolytic therapy. From January to September 2016 we have admitted 271 patients and treated 101 patients with IVT (69% analyzed with CT perfusion), 12/101 (12%) had wake-up stroke (11 at wake-up in the morning and 1 at wake-up in the afternoon) and received treatment after a CT perfusion showing ischemic penumbra.



An emblematic case report

We report an emblematic case of a 87 years-old Caucasian male that was admitted to our Stroke Unit for a WUS with left palsy and speech disorder (NIHSS:13). Brain-CT Scan and angio CT showed right middle cerebral artery occlusion in the M1 tract. CT Perfusion showed a wide penumbra area. IVT was performed and no bleeding or other adverse events occurred. In the following days patient slowly improved and was discharged at rehabilitation department (NIHSS 8).





Conclusions

Neuroimaging selection may identify a subset of patients with wake-up stroke that can safely benefit from acute reperfusion therapies.

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