

perfusion done at the time of presentation. Two sets of managements were arrived at, one determined from only the clinical presentation and the plain head CT-ASPECT score. The second plan was determined with the added CTA and CTP findings. These retrospective management plans were then compared with the actual management of these patients. The reviewing neurologists did not alter the treatment decisions based on the CTP findings because to date, there has been no randomized clinical trial testing CTP findings in acute stroke. So in principle, there was no change in decision making based on CTP information. But in practice, management of two patients was changed based on the CTP results and other clinical findings. In two other patients in our group, treatment did not change the imaging outcome, which was predicted by CTP. CT Perfusion information is being used at our center to determine who might benefit from intra-arterial tPA on a case by case basis.

We believe that the dichotomy of the principle and practice in implementing CTP in the care of acute stroke patients is due to the following important reasons. Firstly, though the physiological basis of CTP imaging findings are theoretically sound, there is no level one evidence to support the extent to which CTP information can change patient management. Secondly, the experience and knowledge in interpreting CTP is still limited. CT Perfusion is currently useful for its qualitative evaluation of cerebral perfusion but limited in its quantitative evaluation. This is largely due to the different post processing algorithm followed by different vendors. Thirdly, there is no established universal standardized protocol for CTP imaging. Due to a lack of good evidence, no established methodology has been established and as a result, each institution has tailored their unique protocol.

When appropriately applied, CTP imaging can be a good predictor of the radiological outcome of stroke. Much has been dedicated to evaluating CTP's theoretical underpinnings, technical implementations and image interpretation. Clinically however, we cannot treat the image on the screen and currently, there is no good evidence of how CTP results can help clinicians manage acute stroke therapy. There is still a stark principle and practice dichotomy in its clinical application of the acute stroke patient care. Before this modality can be incorporated into routine clinical practice, a strong evidence base needs to be

established from which decisions can be made. We ultimately need a well-designed randomized controlled trial. Most of the therapeutic trials are based on the time window and have not shown a huge benefit in terms of final outcome. We believe this was because patients were selected based on time window, but every patient has a unique time window.

With the wide-spread availability of CTP penumbra imaging, we should consider incorporating the viable tissue window in addition to (or perhaps even instead of) the time window alone when making treatment decisions⁵. A therapeutic trial based on treatment to salvage viable tissue based on CTP penumbra imaging instead of by time of onset is the need of the hour and in our opinion is a move towards improved patient management.

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TO THE EDITOR

Acute Neurological Complication in Awake Craniotomy; - A Diagnostic Dilemma

Perioperative neurological complications are less frequently associated with patients undergoing awake craniotomies.¹ However, sometimes intraoperative neurological events warrant alternate diagnosis and management especially, if the cause is not related to surgery. After obtaining written informed consent from the patient, we have highlighted this issue.

A previously healthy young man was admitted to our hospital for investigation and treatment of headache and seizures, for few

months duration. Magnetic resonance imaging demonstrated a mass on left frontal lobe. As the lesion was near the speech center, the patient was scheduled for an awake craniotomy. Surgery proceeded under monitored anesthesia care (MAC), with intravenous infusions of remifentanyl (0.05 mcg /kg /min) and propofol (25 - 30 mcg / kg / min). All standard monitors were attached. Cyclic measurement of noninvasive blood pressure (NIBP) on left arm was stopped after right radial arterial cannulation. Left sided scalp nerves block were performed. The patient's neck was tilted to his right side and a soft bolster was placed under the left shoulder to preventing excessive stretch of the brachial plexus. The patient was comfortable and mildly sedated. At the time of tumor resection, all infusions were

stopped to facilitate verbal communication and monitor the patient's speech. During this time, the patient complained of weakness and numbness in his left arm. The surgeon was asked to pause the procedure and the head frame and shoulder bolster were readjusted, in order to reduce strain on a presumed stretched brachial plexus. Despite repositioning the head frame and adjusting the shoulder bolster, the patient continued to complain of worsening weakness and numbness in his left arm. At this point, the drapes were removed from the left arm. To our surprise, the automated blood pressure cuff was still inflated. We immediately disconnected the NIBP cord and removed the cuff. Within few seconds, all the neurological symptoms on left arm improved and there was no residual deficit. Rest of the intraoperative course was uneventful.

Perioperative neurological complications such as weakness of extremities can be manifestations of multiple etiologies including surgical factors, position related brachial plexus and other neural injuries, worsening of preexisting spine disorders, cervical disc protrusion, stroke and metabolic neuropathies.^{2,3} Most of the above mentioned causes were ruled out in our patient. Peripheral nerve injury is a rare anesthetic complication association with the use of an automatic blood pressure monitor. In many of these reports, patients developed neurological symptoms in the postoperative period.^{4,5} In our case, prolonged inflation of the cuff due to acute kinking of tubing produced ischemic nerve compression and may have provoked the patient's neurological symptoms. Since the patient was sedated until tumor resection, he was unable to appreciate the pain or tightness on the left arm. Fortunately, there was no permanent ischemic injury, which could cause serious complications. In cases of sudden intraoperative upper limb weakness without any apparent surgical cause, one should always suspect non-surgical factors and promptly check for the neck position (extreme rotation, tension on neck muscles), extremity position (extreme

flexion, abduction or adduction) and status of blood pressure cuff (inflation, impingement on cubital fossa).

In conclusion, a simple monitoring method such as NIBP can produce serious neurological complications, which, in neuro-surgical cases, may be incorrectly attributed to surgical causes or inappropriate positioning. Malfunction of the NIBP should be considered in the differential diagnosis, if such an event occurs on the monitoring arm.

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