Traumatic intracerebral hemorrhage after deep brain stimulation

Intracerebral hemorrhage (ICH) is the most significant complication of Deep Brain Stimulation (DBS).

The most feared complication of this surgery is an intracerebral hemorrhage due to the electrode placement, either for intraoperative electrophysiology (microelectrode recording) and/or implantation of the final electrode (macroelectrode).

Tonge et al. have investigated the risk of developing an intracerebral hemorrhage in our cohort of deep brain stimulation patients over a period of 15 years.

They collected demographic data and analyzed the effect of performing surgery with single-electrode versus multiple electrode guided DBS. The effect of using single-dose versus double-dose contrast enhanced MRI to visualize vessels for the electrode trajectory planning has been investigated as well.

They have found that the overall calculated risk of an intracerebral hemorrhage in the series was 1.81% per patient, 0.3% per recording electrode and 0.23% per brain insertion. While three out of four patients recovered without neurological deficits, there was one mortality in a patient with cardiovascular comorbidities. Statistical comparisons between the groups of single-electrode versus multiple electrode guided surgery and single-dose gadolinium versus double-dose contrast enhanced MRI revealed no significant differences. In addition, there was no meaningful correlation between the age at surgery and the risk of bleeding.

They have found that the risk of developing an intracerebral hemorrhage due to deep brain stimulation surgery is low. The clinical course of the patients with an intracerebral hemorrhage was generally favorable [1].

Prevention

To prevent ICH, stereotactic contrast enhanced T1 weighted images are used to visualize vessels as source of hemorrhage. Susceptibility Weighted Imaging (SWI) is an MRI sequence with improved visualization of susceptibility differences between tissues, particularly sensitive for brain veins.

The aim of a prospective study was to analyze the utility of SWI compared to contrast enhanced stereotactic T1-weighted images for trajectory planning of DBS. Preoperative SWI was performed in 33 patients undergoing DBS and was compared to the T1-weighted images. Vessels identified only with SWI in relation to the bilateral planned trajectory were analyzed. In all patients vessels were depicted on SWI only within the planned trajectory (range 1-4 vessels, for each trajectory, mean: 2.4). In 6 patients vessels were identified on SWI adjacent to the target (up to 5mm distal from target). In 11 patients SWI visualized additional cortical veins adjacent to the entry point of the trajectory. The apparent diameter of these vessels ranged between 0.8 and 2.1mm (mean: 1.2mm). Postoperative MRI was compared with preoperative SWI and revealed in two patients small (<3 mm) T2 hyperintense lesions along electrodes without correlation with visualized veins. SWI facilitates the visualization of small veins superior to T1-weighted images. However, cerebral veins within the trajectory were not found to be a significant source of ICH after DBS. Potential sources of ICH are mesencephal veins at the endpoint of electrodes which can cause fatal hemorrhage and are visualized with SWI reliably [2]

1)

Tonge M, Ackermans L, Kocabicak E, van Kranen-Mastenbroek V, Kuijf M, Oosterloo M, Kubben P, Temel Y. A detailed analysis of intracerebral hemorrhages in DBS surgeries. Clin Neurol Neurosurg. 2015 Oct 23;139:183-187. doi: 10.1016/j.clineuro.2015.10.017. [Epub ahead of print] PubMed PMID: 26513430.

2)

Mahvash M, Pechlivanis I, Charalampaki P, Jansen O, Mehdorn HM. Visualization of small veins with susceptibility-weighted imaging for stereotactic trajectory planning in deep brain stimulation. Clin Neurol Neurosurg. 2014 Sep;124:151-5. doi: 10.1016/j.clineuro.2014.06.041. Epub 2014 Jul 7. PubMed PMID: 25051166.