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Smartphone navigated insertion of external ventricular drainages

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Objective

Anatomical landmarks determine primarily the trajectory for placements of external ventricular drainages (EVDs). Nevertheless, non-assisted implantations are frequently complicated by multiple attempts and suboptimal EVDs locations especially if anatomical variants and narrowing of the ventricles exist. Therefore, the authors evaluated the feasibility and accuracy of smartphone-guided angle-adjusted EVDs implantations in both a human artificial and cadaveric model.

Methods

A total of 20 EVDs (skull phantom 8/20, cadaver head 12/20) were implanted. After multi-planar CT 3D reformation a trajectory was set from Kocher's point to the centre of the ipsilateral ventricular frontal horn according to the horizontal and vertical diameter. Intended insertion angles and distances to the catheter tip were measured. The smartphone was calibrated to the mid-cranial sagittal line with the skull in neutral supine position. EVDs were placed using both the measured catheter lengths and smartphone-adjusted insertion angles. Insertion angles and intracranial distance to the catheter tip were measured on postinterventional CT.

Results

All EVDs were placed in the frontal horn of the ipsilateral ventricle as intended. EVDs tip locations showed a mean deviation of 2.76° from the planned trajectory with a 1.93° standard deviation (SD). The mean distance of the EVDs tips to the intended targets was 0.4 cm (SD ± 0.26 cm). The mean duration of measurement of implantation angles and intraventricular lengths was 3 min, and of sterile packing with calibration of the smartphone, drilling and angle-adjusted EVDs implantation 9 min, respectively.

Conclusions

For the first time, a smartphone was used as a tool for placement of EVDs. Our ex vivo study suggests that smartphone-guided EVDs placement represents a precise and fast assisted free-hand technique with a simple and broadly available device.