External ventricular drainage case series

479 external ventricular drainages placed in 409 patients met inclusion criteria, and 9 culture-positive infections were observed during the study period. The risk of infection within 30 days of external ventricular drainage placement was 2.2% (2.3 infections/1,000 EVD days). Coagulase-negative staphylococci were identified in 6 of the 9 EVD infections). External ventricular drainage infection led to prolonged length of stay post-External ventricular drainage placement (23 days vs 16 days; P = .045). Cox regression demonstrated increased infection risk in patients with prior brain surgery associated with cerebrospinal fluid (CSF) diversion (HR, 8.08; 95% CI, 1.7-39.4; P = .010), CSF leak around the catheter (HR, 21.0; 95% CI, 7.0-145.1; P = .0007), and insertion site dehiscence (HR, 7.53; 95% CI, 1.04-37.1; P = .0407). Duration of EVD use >7 days was not associated with infection risk (HR, 0.62; 95% CI, 0.07-5.45; P = .669).

Ventriculostomy related infection risk factors include prior brain surgery, Cerebrospinal fluid fistula, and insertion site dehiscence. Walek et al. found no significant association between infection risk and duration of external ventricular drainage placement [1).

2019

From February 2018 to February 2019, all adult patients admitted to the Union Hospital Neurosurgery Center for EVD placement were eligible for inclusion. After the application of strict exclusion criteria, all enrolled patients were randomly divided into two groups. The patients in Group A received Standard-EVD, and the remaining patients in Group B received Tunneled-EVD. A linear incision was made for T-EVD. The distal end of the catheter was inserted approximately 5 cm until cerebrospinal fluid was readily obtained, and then the catheter was tunneled approximately 4-5 cm from the insertion point. Finally, an external CSF drainage system was connected to the catheter. For the S-EVD patients, they secured the catheter at the original incision site after insertion, and an external CSF drainage system was also connected to the catheter. The rates of ERI were compared between the two patient groups. The odds ratios and χ^2 test were used to analyze the results.

One hundred twenty patients were randomly divided into two groups and underwent EVD placement. Among them, 60 patients in Group A received S-EVD, and 60 patients in Group B received T-EVD. Finally, 51 patients in Group A and 50 patients in Group B met all of the study inclusion/exclusion criteria and were thus eligible for inclusion in the evaluation of ERI rates. All clinical features of the two groups were similar. A total of 12 patients' (11.9%) CSF cultures were positive for infection. Ten (19.6%) patients who underwent S-EVD had CSF-positive cultures, while only 2 (4.0%) patients who underwent T-EVD had CSF-positive cultures (P = 0.034). Additionally, 8 patients in Group A and 1 patient in Group B were complicated with CSF leakage (P = 0.039).

Compared to S-EVD, T-EVD, when performed according to a previously established perioperative management protocol, resulted in lower infection and CSF leakage rates. We recommend that T-EVD should be preferentially performed when surgeons determine whether a catheter can be removed within 10 days, and the catheter used for EVD should be removed as soon as permitted by the clinical circumstances [2).

2017

In 155 patients Ortolano et al. studied the brain tissue surrounding the EVD by CT scan (all patients) and MRI (16 patients); 53 patients were studied at three time points (day 1-2, day 3-10, >10 days after EVD placement) to document the lesion time course. Small hemorrhages, with a hyperdense core surrounded by a hypodense area, were identified by CT scan in 33 patients. The initial average (hyper- + hypodense) lesion volume was 8.16 ml, increasing up to 15 ml by >10 days after EVD insertion. These lesions were not accompanied by neurologic deterioration or ICP elevation. History of arterial hypertension, coagulation abnormalities and multiple EVD insertions were significantly associated with hemorrhages. In 122 non-hemorrhagic patients, they detected very small hypodense areas (average volume 0.38 ml) surrounding the catheter. At later times these hypodensities slightly increased. MRI studies in 16 patients identified both intra- and extracellular edema around the catheters. The extracellular component increased with time.

EVD insertion, even when there are no clinically important complications, causes a tissue reaction with minimal bleedings and small areas of brain edema [3].

2016

Arroyo-Palacios et al performed a retrospective study with 50 aSAH patients with reported weaning trial admitted to our institution between 03/2013 and 08/2014. By reviewing clinical notes and pre/post-brain imaging results, 32 patients were determined as having passed the weaning trial and 18 patients as having failed the trial. MOCAIP algorithm was applied to ICP signals to form a series of artifact-free dominant pulses. Finally, pulses with similar mean ICP were identified, and amplitude, Euclidean, and geodesic inter-pulse distances were calculated in a 4-h moving window.

While the traditional measure of mean ICP failed to differentiate the two groups of patients, the proposed amplitude and morphological inter-pulse measures presented significant differences ($p \leq 0.004$). Moreover, receiver operating characteristic (ROC) analyses showed their usability to predict the outcome of the EVD weaning trial (AUC 0.85, $p < 0.001$).

Patients with an impaired CSF system showed a larger mean and variability of inter-pulse distances, indicating frequent changes on the morphology of pulses. This technique may provide a method to rapidly determine if patients will need placement of a shunt or can simply have the EVD removed [4].

2013

170 ventricular catheters were freehand passed, 51 were placed using stereotactic neuronavigation, and 28 were placed under intraoperative ultrasonic guidance. There was a statistically significant difference between freehand catheters and stereotactic-guided catheters ($p<0.001$), as well as between freehand catheters and ultrasound-guided catheters ($p<0.001$). The only risk factor for inaccurate placement identified in this study was use of the freehand technique. The use of stereotactic neuronavigation and ultrasonic guidance reduced proximal shunt failure rates ($p<0.05$) in comparison with a freehand technique.

Stereotactic- and ultrasound-guided ventricular catheter placements are significantly more accurate than freehand placement, and the use of these intraoperative guidance techniques reduced proximal shunt failure in this study [5].

2009

A total of 138 patients underwent 212 ventriculostomy procedures. Seventy-one (51%) patients were male and sixty-seven (49%) were female. The median age was 50.1 years. A ventriculostomy-related hemorrhage was identified in 15 (7.1%) patients-4 of whom developed new symptoms. Twenty-six (12.3%) ventriculostomy catheters were malplaced as determined from post-procedural imaging. Ventriculostomy-related infections were identified in 7 (3.3%) patients, 4 of whom had EVDs and 3 of whom had VP shunts.

The placement of intraventricular catheters by neurosurgeons remains a relatively safe and effective procedure that is associated with infrequent rates of symptomatic hemorrhage and infection [6].

A retrospective review of 138 consecutive patients with hydrocephalus undergoing freehand initial shunt surgery. Of these, 79 had a post-operative brain scan and therefore the results were available for analysis. Scans were graded for successful catheter tip placement in the ventricular target zones: the frontal horn for frontal and occipital approaches, and the atrium for the parietal approach. Ventricular target zones were successfully catheterized in 85% of parietal and 64% of frontal shunts (this difference is not statistically significant). In contrast, only 42% of occipital shunts were correctly placed ($p<0.01$). Therefore, parietal and frontal catheters are more likely to be placed successfully in the target ventricle. This may be due to the smaller range of successful trajectories open to the occipital approach. Solutions to this problem may include using the theoretically favourable frontal approach for freehand surgery or using stereotactic guidance [7].

2007

Ferguson et al. analyzed the independent predictors of shunt survival in 116 failed shunt placement procedures (infection or malfunction) by performing univariate and multivariate factorial analyses. Analysis of the 116 failed shunts in the 396 new shunt placement procedures performed revealed that age was a significant independent predictor of shunt survival time in failures due to malfunction ($p < 0.05$) as well as infection ($p < 0.05$). In addition, a significant relationship between patient race and shunt survival was also found. As suggested by data in other studies focused on this outcome, early shunt failure occurs sooner in younger patients. Interestingly, this study is one of few whose data have revealed that race may affect shunt failure after implantation. Specifically, shunt failure due to infection resulted in significantly shorter shunt survival time in non-white patients compared with that in white patients. Among the shunts that failed due to malfunction, however, white patients had shorter shunt survival times [8].

Thirty-four ventricular catheters were placed using a Medtronic electromagnetic frameless neuronavigational system (Medtronic Navigation, Inc., Louisville, CO) during a 12-month period. The patients ranged in age from 11 months to 79 years; the mean age was 40.8 years. Nineteen male and 12 female patients participated in the study. The indications for ventricular catheter placement included obstructive hydrocephalus, normal pressure hydrocephalus, pseudotumor cerebri, intrathecal therapy, and tumor cyst aspiration.

No proximal failures have been reported to date. One infection necessitated shunt removal. Three postoperative deaths occurred because of non-catheter-related events.

Frameless neuronavigation in the placement of ventricular catheters assures accurate catheter placement, thereby decreasing the incidence of proximal catheter failure. The absence of rigid head fixation allows additional cohorts to benefit from the apparatus. The use of the electromagnetic system provides a safe, simple, and easy adjunct to optimal catheter placement [9].

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