Supplemental Digital Content 3: Protocol to prevent external ventricular drain-related ventriculitis from Korinek et al.[1]

EVD insertion

All EVD were inserted in the operating theater. Hair was entirely clipped and then shampooed with Betadine ScrubTM; the scalp was disinfected with iodine alcohol twice. The catheter was inserted into the lateral ventricle usually in the right frontal horn, through a 4 mm burr hole. After insertion, the EVD catheter was tunneled laterally under the scalp for a few centimeters. The drainage system (DE 210, Sophysa, Orsay, France) was then connected to the catheter, and proximal and distal three-way taps were protected in a sterile box (RP 1000, Asept In.Med, Le Faget, France). A sterile dressing, covering the entire head was applied. A CSF sample was systematically sent to the laboratory for biochemistry, cell count, Gram staining and culture. A pressure line was connected to the proximal three-way tap (Transpac+, ABBOTT, Sligo, Republic of Ireland), after sterile saline rinse of the line by the surgeon. Prophylactic antibiotics were given for emergency EVD (single dose of 2 g=200 mg amoxicillin and clavulanic acid given in the operating theater before scalp incision). At the end of surgery, an antiseptic shampoo was performed and a sterile head dressing was applied.

EVD care

In the intensive care unit, head dressing was changed every 3 days, and the hair shampooed every 6 days throughout the period the EVD was in place. The closed drainage system was strictly respected: switching between pressure monitoring and CSF drainage was done by clamping the drainage tubing, with no manipulation of the 3-way tap; the drainage bag was emptied only when it was full. Manipulations were strongly discouraged: rinsing of the catheter was forbidden. If drainage stopped, a CT scan of the brain was performed to determine if the catheter was still in place or if the ventricles were collapsed. In this latter case, the catheter was left in place. In case of catheter displacement or complete blockage, a new EVD was inserted on the opposite side using the same protocol.

Routine culture of CSF was not performed because it could possibly contaminate the drainage system. A CSF sample was drawn from the drainage bag if the patient had fever or alteration of neurological status with no other apparent cause. If the CSF was abnormal (positive gram staining or increased white cell count), a CSF sample was aseptically taken through the proximal 3-way tap. At EVD removal, every catheter was sent for culture and

the skin was carefully sutured. EVD infection was defined according to Overturf's criteria as shunt dysfunction with fever 38°C or higher or peritoneal symptoms or purulent discharge along the shunt track, positive cultures from the ventricular catheter and/or shunt reservoir and/or distal catheter, and antibiotics prescribed by the attending physician. EVD-related ventriculitis was defined as ventricular CSF containing more than 5 leukocytes with the same microorganism growing in the shunt device and CSF cultures.

EVD surveillance

A special file for EVD surveillance was instituted and prospectively filled. The file included: respect of surgical protocol (hair clipping and tunneled catheter), dates of dressing changes and shampoos, forbidden manipulations, CSF samplings, EVD bag emptying, daily maximal temperature, CSF aspect and volume, cause of EVD removal, result of catheter culture, and presence of a CSF leak. When a patient needed more than one EVD, a new EVD file was completed for each new procedure.

Abbreviations: CSF: cerebrospinal fluid; CT: computed tomography; EVD: external ventricular drain

Supplemental Reference

1. Korinek AM, Reina M, Boch AL, Rivera AO, De Bels D, Puybasset L: Prevention of external ventricular drain-related ventriculitis. Acta Neurochir (Wien) 2005; 147:39-45