Complications associated with continuous CSF drainage in patients with SAH

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Researchers at Duke University conducted a randomized clinical trial in patients with subarachnoid hemorrhage (SAH). In this study, the researchers compared two approaches to intracranial pressure management—continuous and intermittent drainage of cerebrospinal fluid (CSF)—and outcomes associated with those methods, focusing specifically on the incidence of cerebral vasospasm. The study had to be closed approximately midway due to a high rate of complications (52.9%) in the group of patients in whom CSF was drained continuously. Details of the study and findings are reported and discussed in "Continuous cerebral spinal fluid drainage associated with complications in patients admitted with subarachnoid hemorrhage. Clinical article," by DaiWai M. Olson, Ph.D., R.N., Meg Zomorodi, Ph.D., R.N., Gavin W. Britz, M.D., M.B.B.Ch., M.P.H., Ali R. Zomorodi, M.D., Anthony Amato, R.N., B.S.N., and Carmelo Graffagnino, M.D., published today online, ahead of print, in the *Journal of Neurosurgery*.

This study was a prospective observational clinical trial, registered at ClinicalTrials.gov, which was undertaken to determine whether cerebral vasospasm (narrowing of major cerebral arteries) was less likely to occur when patients with subarachnoid hemorrhage (SAH) were treated with continuous or intermittent cerebrospinal fluid (CSF) drainage. The patient population consisted of adult patients who had been admitted to the Neurocritical Care Unit with the primary diagnosis of aneurysmal SAH and whose treatment included CSF drainage and Intracranial pressure monitoring via an external ventricular drain (EVD). All patients were treated according to the Center's standards of care both for

treatment of SAH and for prevention and treatment of cerebral vasospasm. Only the methods of CSF drainage and intracranial pressure monitoring differed.

Patients were randomly assigned to one of two treatment groups. In one group of patients, CSF was drained continuously and intracranial pressure was monitored intermittently (34 patients); in the other group, CSF was drained intermittently in response to changes in intracranial pressure, which was monitored continuously (26 patients). The primary objective of the study was to see which of these methods could reduce the patient's risk of developing cerebral vasospasm. For the purposes of the study, cerebral vasospasm was diagnosed if two forms of evidence were both present: clinical evidence based on the patient's symptoms; and imaging evidence provided by transcranial Doppler ultrasonography and also, in some cases, by regular angiography or computed tomography angiography.

Originally, the researchers planned on enrolling 100 patients into the clinical trial. However, an interim analysis of data collected after the first 60 patients completed the trial led to early termination of the study. The researchers found a 52.9% complication rate in the group of patients in whom CSF drainage was continuous, whereas they found only a 23.1% complication rate in the group of patients in whom CSF drainage was intermittent. Given the significantly higher complication rate ($p = 0.0223$) in the former group of patients, a decision was made by the Data Safety and Monitoring Board (DSMB) to close the clinical trial.

Complications in this study included CSF leakage, intracranial hemorrhage, unplanned removal of the EVD, infection of the ventricles, and a nonpatent or clogged EVD. The most serious complication was infection of the ventricles. Although the difference in the rates of infection in the two patient groups was clinically relevant (continuous

CSF drainage 17.6% vs. intermittent CSF drainage 3.8%), this difference was not significant (p = 0.1322). Nevertheless, the researchers state that the rate of infection in the continuous CSF drainage group was two times the average rate reported in the literature. The most common complication was a loss of patency in the EVD catheter, which required flushing or replacement (continuous CSF drainage 44.1% vs. intermittent CSF drainage 11.5%; p = 0.0276). According to the authors, "Important in the DSMB decision to stop enrollment was the strong association (alpha = 0.01) between infection and a nonpatent EVD, without regard to group assignment [odds ratio 7.96], combined with the statistically significantly higher odds of a nonpatent EVD in the open-EVD [that is, continuous CSF drainage] group [odds ratio 4.35]."

The researchers were unable to complete the trial, and thus they were unable to reach their primary objective, that is, the identification of which method of CSF drainage would be associated with a reduced risk of developing cerebral vasospasm. Nevertheless, the researchers found "a trend toward significance" favoring the group of patients in whom CSF was drained continuously. Although no one knows what the results of the complete study would have been, the researchers state that "one could speculate that the trend toward significance suggests that, if a mechanism could be determined to reduce the risk of complications from open-EVD [continuous CSF drainage], there is a potential for reducing the risk of vasospasm and thereby benefiting the patient."

More information: Olson DM, Zomorodi M, Britz GW, Zomorodi AR, Amato A, Graffagnino C. Continuous cerebral spinal fluid drainage associated with complications in patients admitted with subarachnoid hemorrhage. Clinical article. *Journal of Neurosurgery*, published online, ahead of print, August 20, 2013; DOI: 10.3171/2013.6.JNS122403