



Long-term Outcomes after Intraventricular Thrombolysis and Endovascular Therapy for High-Grade Aneurysmal Subarachnoid Hemorrhage

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Learning Objectives

Participants should be able to: 1) Describe the rationale for intraventricular thrombolysis after aneurysmal subarachnoid hemorrhage, and 2) Describe its related potential risks and benefits.

Introduction

Chemical thrombolysis with intraventricular tissue plasminogen activator (TPA) after endovascular aneurysm occlusion, may offer benefit related to accelerated clot clearance from the subarachnoid and intraventricular spaces. We examined the long-term results of our local policy of treating patients with high-grade aneurysmal subarachnoid hemorrhage, with intraventricular TPA after endovascular aneurysm occlusion with a view towards safety and feasibility.

Methods

From 2002-2007, we initiated an institutional protocol of acutely treating selected patients with high-grade SAH (Hunt-Hess grades 3-5) and large volume subarachnoid and intraventricular hemorrhage (Fisher grades 3-4) after aneurysm occlusion, with intraventricular dose(s) of TPA. Long-term follow-up of clinical recovery and radiological surveillance was performed annually or more in a specialty clinic for up to 10 years. Clinical outcomes were classified at last follow-up by the senior neurosurgeon using the modified Rankin scale in a non-blinded fashion. Retrospective chart review was performed for accrual of in-hospital data for analysis.

Results

Twenty-two patients (64% female, mean age 55 years) were identified. All except one had diffuse thick SAH with intraventricular blood, and all required external ventricular drainage as part of routine care. Six patients were initially classified as Hunt-Hess grade 5, 12 patients were grade 4, and 4 were grade 3. The most common aneurysm location was in the anterior communicating artery territory in 12 cases (55%) and mean aneurysm size was 9 mm (range 3-18 mm).

Results (continued)

All were treated acutely by coil embolization except two with n-acetyl cyanoacrylate and their aneurysms were deemed satisfactorily occluded. All patients underwent (repeated) daily dosing of TPA, typically in 4 mg aliquots, via the ventriculostomy catheter. Our typical protocol involved withdrawal of CSF, slow instillation of TPA (1:1 mix with sterile water) and clamping of the ventriculostomy catheter for 15-60 minutes depending upon brain compliance. The drain would be leveled at 5-10 cm H2O and opened to drain and daily CT scans were performed. Mean dose was 5.8 mg (range 2-12 mg) until subarachnoid clot was deemed substantially cleared. Vacular imaging for vasospasm via digital subtraction angiography or CT angiography was performed at post-SAH day 7-12. Serial imaging showed evidence of significant new bleeding after treatment in two patients (9%) but the remaining 91% of patients had substantial reduction in amount of intracranial blood. Followup angiography in 16 patients showed three had severe radiologic vasospasm (19%), one moderate (6%), five mild (31%), and seven none (44%). No patient developed large-vessel territory infarction. Two moribund patients died due to refractory intracranial hypertension. Six patients (30%) required ventriculo-peritoneal shunt insertion for post-hemorrhagic hydrocephalus. Long-term clinical follow-up of 17 survivors showed no to slight disability in 9 (53%), moderate disability in 4 (24%), and severe disability in 4 (24%).

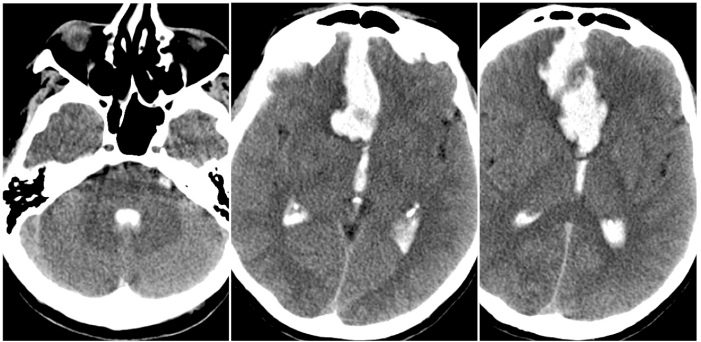
Conclusions

In high-grade aneurysmal SAH, endovascular aneurysm treatment combined with intraventricular thrombolysis is feasible, accelerates clearance of subarachnoid and intracranial blood, and may be associated with favorable long-term outcomes. This experience provided valuable guidance for the development and successful completion of a subsequent pilot randomized controlled trial conducted at our institution, examining the use of TPA in the post-procedural managment of aneurysmal SAH (see reference).

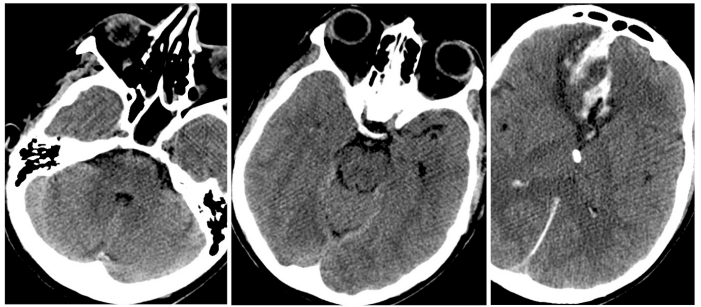
References

1. Intraventricular Tissue Plasminogen Activator in Subarachnoid Hemorrhage Patients: A Prospective, Randomized, Placebo-Controlled Pilot Trial. Kramer AH, Roberts DJ, Holodinsky J, Todd S, Hill MD, Zygun DA, Faris P, Wong JH. Neurocrit Care. 2014 Mar 14. PMID: 24627207

Case Example



48 year old femaie, Hunt-Hess grade 4 and Fisher grade 4 SAH, Ruptured 12 mm Acomm aneurysm



Follow-up CT after aneurysm coiling, and repeated daily TPA administration. No clinical vasospasm or hydrocephalus developed. Complete neurological recovery noted in long-term follow-up.