VGAMs are rare congenital lesions with enlarged deep venous structures of the galenic system that are fed by abnormal midline arteriovenous communications. The neonates and infants present with symptoms ranging from severe high output congestive heart failure to seizures, macrocephaly and mental retardation (1). The natural history of these lesions is mostly depressing especially in the neonatal group. Overall mortality are known to range from 42-91% when untreated (2). Endovascular embolization is the treatment of choice with the goal of occluding the shunt and the vein via the arterial route or by occluding the ectatic vein from the venous route (1).

We present a case of VGAM successfully treated by transarterial embolization of the venous sac and the fistula of a single hole type VGAM using coils and glue.

**CASE REPORT**

A male neonate was born by normal vaginal delivery after a normal pregnancy. Prenatal sonography had revealed a brain vascular lesion suspicious of VGAM. MR imaging and angiography showed an enlarged mural type vein of Galen measuring 2.3 cm in diameter. The feeder was a single fistula type from the right posterior choroidal artery to a nipple like protrusion on the anterior aspect of the vein of Galen with drainage into the falcine sinus. There was no evidence of major cerebral parenchymal damage, hydrocephalus, or hemorrhage. Echocardiogram was grossly normal without signs of cardiac failure except for peripheral pulmonary stenosis.

At 3 months of age, transarterial embolization of the venous sac was performed through the single hole type fistula. Using a 4F catheter, the left vertebral artery was selected and a Prowler 14 microcatheter (Cordis, Miami, FL) with 014 Synchro microwire (Boston Scientific, Fremont, CA) were used for navigation into the targeted sac. After successfully crossing into the venous sac, coil embolization of the venous sac and the nipple like protrusion site were performed using Trufill complex 20/30 (diameter/length (mm), Cordis, Miami, FL), microplex 20/50 (× 3, Microvention, Aliso Viejo, CA).
CA), Trufill complex 18/30 (x2), 16/30, 8/24 (x2), 7/21, 5/15, 4/10 and 3/8 coils. Final angiogram revealed complete occlusion of the fistula. The patient was discharged without any neurological complications.

Three months later, the patient presented with seizures. Brain MR and MRA revealed the newly developed hydrocephalus with reopening of the fistula. Repeat angiogram showed complete occlusion of the fistula. The patient was discharged without any neurological complications.

DISCUSSION

VGAM is a rare condition that most often affects children. VGAMs may be subdivided into two distinct categories: choroidal and mural types, based primarily on their angioarchitecture. Choroidal VGAMs demonstrate an abundance of arterial supply from choroidal arteries, pericallosal arteries, and/or subependymal branches of the thalamoperforating vessels. The shunt is extracerebral, subarachnoid, and

including the nipple like protrusion site was embolized with 50% histoacryl (B Braun, Tuttlingen). Final angiogram revealed the complete occlusion of the fistula. The patient did not show any newly developed neurologic signs on the next 5 month follow up.
communicates with the anterior aspect of the median vein of the prosencephalon. The choroidal type typically presents with heart failure in the neonate. Mural-type VGAMs harbor a lesser number of connections arising from the collicular or posterior choroidal artery branches. Patients with mural-type VGAMs present with macrocephaly or failure to thrive, and cardiac failure is typically mild or absent (1). Endovascular therapy is the treatment of choice in most cases. Transarterial, transvenous, and transtorcular approaches have been implemented with consideration of the individual angioarchitecture for treatment of the lesions (1, 3-5). However, whenever possible, the transarterial route is recommended first due to the significant reduction in the risk of immediate or delayed hemorrhagic complications. If the venous route is used, other cerebral venous connections to the aneurysmal vein should be carefully evaluated before occlusion (1, 6).

In our case of a mural type VGAM with a single fistula, transarterial embolization of the lesion was performed. However, due to the high flow shunt and possibility of pulmonary embolism, the venous sac was accessed via the transarterial route and completely embolized with coils through the fistula site. Transarterial venous sac selection has been described as a feasible option for venous sac embolization in VGAM (3).

The selection of the optimal embolic material for treatment of VGAMs has been controversial. Some recommend the use of fibered and unfibered detachable coils due to their ability to reposition for exact localization and prevention of distal migration (3, 7). However, many strongly advocate the use of glue due to its advantages in terms of permanent occlusion, better ability for injection in small tortuous feeders, reduced time of procedure and cost (6, 8). Despite achieving an initial complete occlusion with coils in our case, the patient showed recanalization with compaction of the coils after 3 months of follow up. The recurred lesion was successfully managed by combined transarterial coil embolization of the venous sac for flow reduction and glue embolization for permanent occlusion of the desired targeted site.

In conclusion, the strategy for treatment of VGAMs should be carefully planned according to the individual angioarchitecture. These lesions may be successfully treated by transarterial embolization of the venous sac and the fistula with combined use of coils and glue.

References
Key Words: Embolization; Therapeutic; Intracranial arteriovenous malformation; Vein of Galen