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Delayed presentation of an arteriovenous malformation after cerebellar hemangioblastoma resection—Case report



E. Emily Bennett, Balint Otvos, Varun R. Kshetry, Jorge Gonzalez-Martinez*

Department of Neurological Surgery, Neurological Institute, Cleveland Clinic, Cleveland, OH, USA

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ABSTRACT

INTRODUCTION: Haemangioblastoma has been uncommonly reported to occur in coexistence either temporally or spatially with the development of an arteriovenous malformations (AVM). We present a case of a delayed AVM following haemangioblastoma resection.

PRESENTATION OF CASE: 44 year old female initially presented with a several week history of headaches, vertigo and nausea and emesis and was found to have a cystic lesion with a solid enhancing component on Magnetic Resonance Imaging (MRI) in the superior aspect of the vermis. She underwent gross total resection and final pathology was consistent with WHO grade I haemangioblastoma. One year later, patient re-presented with headaches, dizziness and left trochlear nerve palsy with rotary nystagmus. Imaging revealed a left posterior tentorial paramedian cerebellar vascular nidus with venous drainage into the left transverse sinus suspicious for arteriovenous malformation. She underwent gross total resection of the lesion. Final pathology confirmed the diagnosis of an arteriovenous malformation.

DISCUSSION: Recent research supports both haemangioblastoma and AVM are of embryologic origin but require later genetic alterations to develop into symptomatic lesions. It is unclear in our case if the AVM was present at the time of the initial haemangioblastoma resection or developed de novo after tumor resection. However, given the short time between tumor resection and presentation of AVM, de novo AVM although possible, appears less likely.

CONCLUSION: AVM and haemangioblastoma rarely presents together either temporally or spatially. We present a case of a delayed AVM following haemangioblastoma resection. More research is needed to elucidate the rare intermixture of these lesions.

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1. Introduction

Haemangioblastoma has been infrequently reported to occur in coexistence either temporally or spatially with the development of an arteriovenous malformations (AVM) [1]. The first report was in 1965 by Raynor and Kingman where they described a case of coexistence of cerebellar AVM and haemangioblastoma [2]. Since that time a limited number of related neoplasms and vascular malformations have been reported including oligodendroglioma and astrocytoma with AVM and cavernous malformations. Medvedev et al. reported the only other coexistent haemangioblastoma and AVM in the cerebellum in 1991 [1]. We report a case of cerebellar AVM development after resection of cerebellar haemangioblastoma.

2. Case presentation

Patient is a 44-year-old female with past medical history of recurrent sinusitis, malaria, and Hepatitis A and who initially presented to the emergency department with a several week history of headaches, vertigo, nausea and vomiting. On physical examination, the patient was neurologically intact.

A contrast enhanced Computerized Tomography (CT) scan of the head demonstrated a midline posterior fossa cystic lesion with surrounding vasogenic edema resulting in effacement of the fourth ventricle and obstructive hydrocephalus (Fig. 1a). Magnetic resonance imaging (MRI) confirmed a cystic lesion with a solid enhancing $1.6 \times 1.4 \times 1.1$ cm component in the superior aspect of the vermis near the tentorial edge (Fig. 1b–d). She was taken to the operating room for resection the following day. In the sitting position, a stereotactic supracerebellar infratentorial approach was performed for resection of the solid portion of the mass after drainage of the cystic portion. We noted the utmost importance of the close proximity of this tumor to the internal cerebral veins and basal veins of Rosenthal. Post-operative MRI demonstrated gross total resection (Fig. 2). Final pathology confirmed World Health

* Corresponding author at: Cleveland Clinic, Neurological Institute, 9500 Euclid Avenue S60, Cleveland, OH, USA.

E-mail address: gonzalj1@ccf.org (J. Gonzalez-Martinez).

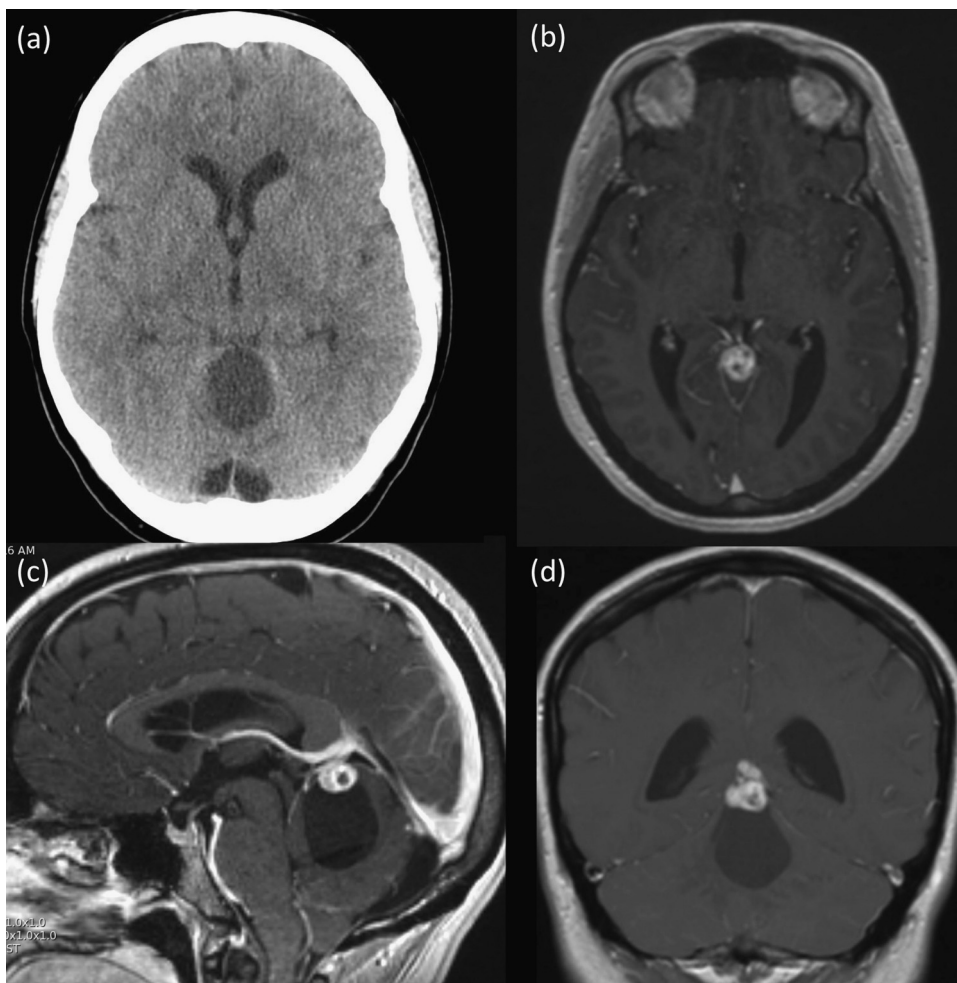


Fig. 1. (a) Axial CT without contrast demonstrating cystic midline posterior fossa lesion with mild obstructive hydrocephalus. Axial (b), sagittal (c), and coronal (d) volumetric T1 with gadolinium MRI demonstrating enhancing lesion at the tentorial apex adjacent to the vein of galen with large cystic component with the cerebellum.

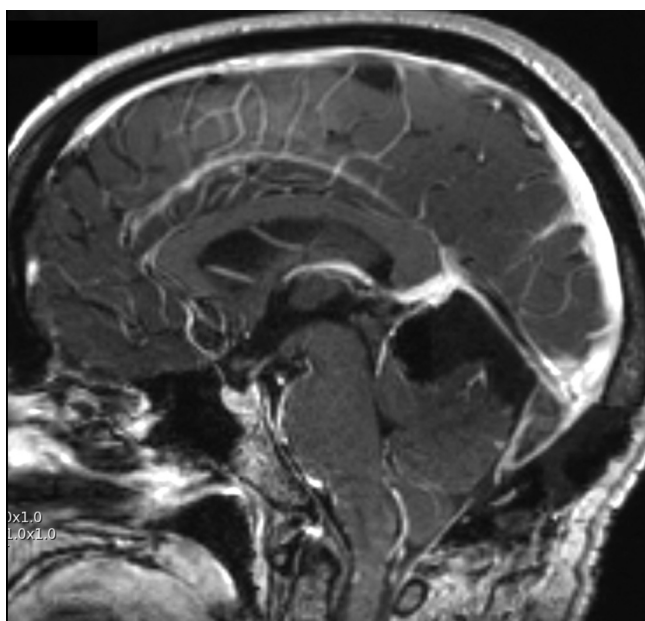


Fig. 2. Postoperative sagittal volumetric T1 with gadolinium demonstrating gross total resection after supracerebellar infratentorial approach.

Organization (WHO) grade I haemangioblastoma. Patient had an unremarkable post-operative course and was discharged home on post-operative day 3. At her 6 week and 6 month post-operative visits, she was doing well. She underwent CT abdomen, dilated ophthalmologic examination, and full neuroaxis MRI to rule out any additional lesions suggestive of von-Hippel-Lindau disorder, all of which were unremarkable. Repeat MRI revealed no recurrence of the lesion (Fig. 3). Of note, she did have intermittent vertigo and headaches following her original resection. She was diagnosed with migraines and they improved with conservative management.

One year after her original surgery, she presented to the emergency room after a 2-day history of headaches with increased dizziness resulting in a fall from standing. Neurological examination showed left trochlear nerve palsy and rotary nystagmus. There were no other neurological deficits. CT scan of her head demonstrated an acute left tentorial subdural hematoma as well as a small left cerebellar intracranial hemorrhage (Fig. 4a). Further CT angiography and MRI demonstrated a nodular focus of enhancement on the medial margin of the left cerebellar hemorrhage raising concern for new or recurrent haemangioblastoma (Fig. 4b–d). Diagnostic digital subtraction angiogram (DSA) was then performed and demonstrated a $2.4 \times 0.9 \times 1.0$ cm left posterior tentorial paramedian cerebellar vascular nidus primarily supplied by bilateral posterior inferior cerebellar arteries and left superior cerebellar artery with venous drainage into the left transverses sinus suspicious for arteriovenous malformation (Fig. 5a, b). In addition, there was a 2.5×2.0 mm intranidal aneurysm (Fig. 5c, d). There-

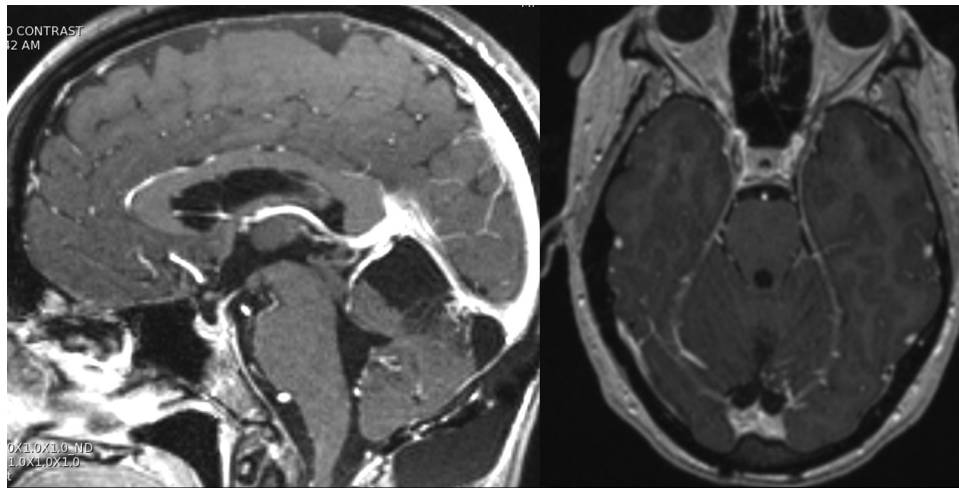


Fig. 3. Sagittal (*left*) and axial (*right*) volumetric T1 with gadolinium at six month follow-up demonstrating no tumor recurrence, but some subtle increased vascularity at the posterior tentorium along the left vermis.

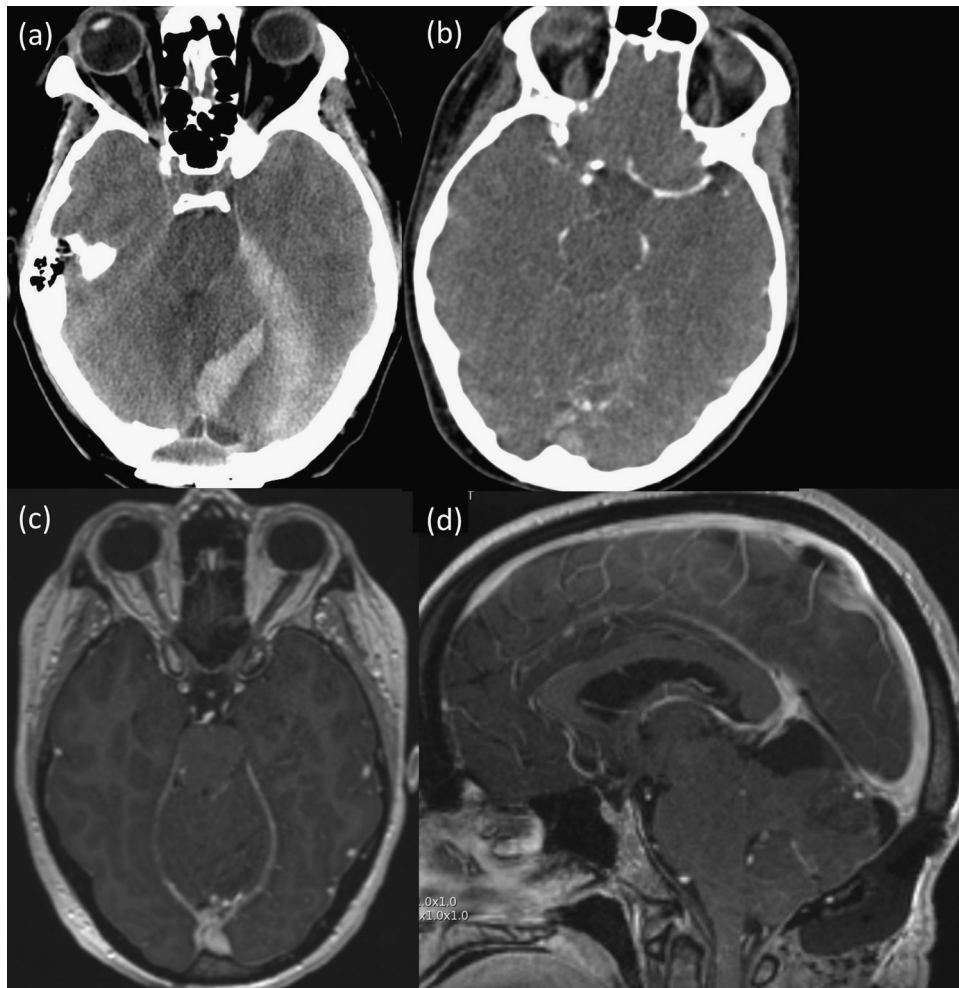


Fig. 4. (a) Axial CT without contrast demonstrating left tentorial acute subdural hematoma and intraparenchymal hemorrhage with the left cerebellar hemisphere. (b) Axial thin-slice CT angiogram (CTA) and axial (c) and sagittal (d) volumetric T1 with gadolinium demonstrating subtle increased vascularity along posterior tentorium along the left vermis.

fore, we believed the source of her hemorrhage was most likely due to rupture of her AVM. Laboratory workup for pheochromocytoma was negative. She was taken to the operating room for another supracerebellar infratentorial approach through the old scar in prone position for resection of the vascular lesion. Compared

to her original surgery where the hemangioblastoma was found near the anterior apex of the tentorium along the vermis, the AVM was found more posterior with bridging veins directly into the tentorium. A gross total resection was performed. Post-operatively, her neurological status remained the same. A diagnostic angiogram on

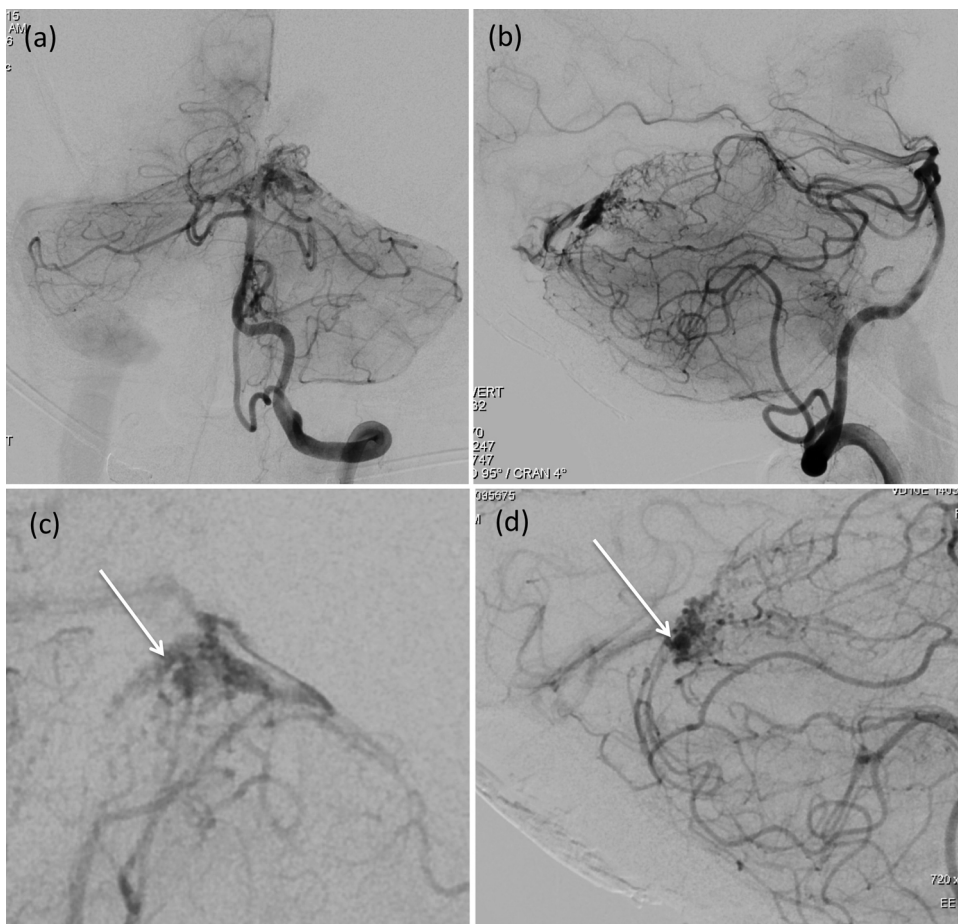


Fig. 5. AP (a) and Lateral (b) digital subtraction angiography with left vertebral artery injection demonstrating a $2.4 \times 0.9 \times 1.0$ cm left paramedian posterior tentorial arteriovenous malformation being fed by bilateral posterior inferior cerebellar arteries and the left superior cerebellar artery. Venous drainage is through the torcula into the right transverse sinus. AP (c) and Lateral (d) digital subtraction angiography demonstrating small 2.5×2.0 mm intranidal aneurysm (white arrow).

post-operative day 1 demonstrated no residual lesion. Histopathology confirmed the diagnosis of an AVM. She was discharged home on post-operative day 3 in stable condition and has been doing well since that time.

3. Discussion

Haemangioblastoma are benign vascular tumors that occur in the posterior fossa in 7–12% of cases [3,4]. They can occur sporadically or with von-Hippel-Lindau disease. These tumors may appear solid, solid-cystic or primarily cystic with a vascular mural nodule composed of stromal cells and abundant capillaries.

Histologically there is no distinct differentiation between the solid and cystic types; both displaying a proliferation of endothelial cells and foam cells. The stromal cells are the underlying neoplastic cells [5]. Pericytes also surround the endothelial cells which creates extensive vascular channels that encase the vacuolated stromal cells [6].

Recent studies have proposed that in von Hippel-Lindau disease haemangioblastomas develop during embryogenesis. The haemangioblast which are embryonic precursors of both hematopoietic and endothelial cells are the centre point of this development [5–7]. The haemangioblast may arrest in these individuals but later reactivate to form haemangioblastomas [5,8–11]. Others point out that haemangioblastomas are rarely seen in younger children. Park et al. have proposed that tumor growth may be slow and so are below detectable level on imaging for years [5]. However, most embryologic studies of haemangioblastoma have

been done on tumors associated with von Hippel-Lindau disease, and therefore these findings may not relate to sporadic haemangioblastomas.

Compared to haemangioblastoma, the development of AVMs has been historically described as congenital. AVMs are classified typically as sporadic or syndromic in origin. During the 3rd week of embryogenesis, angioblasts differentiate from mesoderm and form arterial, venous, and capillary vessels [1]. An AVM is a direct abnormal arterial and venous connection without intervening capillaries. Recently Ramey et al. proposed a hierarchical model involving this derangement of angioblasts during development [12]. In this model, higher-flow parent arteries first give rise to lower-flow veins to form an AVM precursor, and single nucleotide polymorphisms (SNPs) are required to mature the AVM into clinical significance.

More recently, the congenital origin of AVM has been questioned. Morales-Valero et al. highlight the infrequency in which AVMs are diagnosed in the neonatal period [13]. In addition, they reported 16 patients who developed de novo AVMs after negative imaging in the preceding 2–17 years. However, only 6 of these patients were initially evaluated with DSA, which could have partially attributed to the lack of positive findings on initial imaging. Similarly to haemangioblastoma, the exact mechanism for AVM formation has not been clearly explained but is likely multifactorial [12,13].

In 2013, Yano et al. reported 74 cases of brain tumors associated with AVM. Most commonly, oligodendroglioma was the glial tumor type associated with AVM. Traditionally, glial tumors asso-

ciated with AVM have been described as “separate,” “intermixed,” or “adjacent” based on their positional relation with “intermixed” being most common [14]. “Separate” describes a tumor that exists as a distinct lesion from an AVM at the time of diagnosis [15]. AVMs and tumors have occurred in the same location at different time periods, as well. Whereas, “intermixed” or “coexistent” lesions are the pathological finding of brain tumor and AVM in the same lesion, and these lesions are therefore termed physically intermingled [1]. The term angioglioma has been used to describe such lesions. Lastly, “adjacent” refers to two discrete lesions that are neighboring each other.

Many theories have been proposed for why glia tumors are associated with AVMs. Historic theories such as gliomas arising from gliotic tissue around an AVM and viral influences resulting in coexistent lesions appear less likely. Medvedev et al. proposed a common embryologic origin as a possible explanation of the coexistence of AVMs and haemangioblastomas [1]. Recent research has suggested both haemangioblastoma and AVM may have embryologic origins but also require further genetic alterations to mature into clinically significant lesions. Our patient presented with haemangioblastoma but one year later was also found to have a clinically significant AVM in the vicinity of the resected tumor but not precisely in the same location (AVM was located more posterior to the original anteriorly located hemangioblastoma). It is possible a clinically significant AVM was coexistent with the haemangioblastoma at the time of diagnosis but the fact that no pathological vessels (suggesting AVM) were observed during the tumor resection surgery makes this hypothesis unlikely. However, it could be conceivable if the original AVM had a very small size. The patient was followed with serial MRI but never had an angiogram performed until she re-presented with hemorrhage. On her six and twelve month follow-up MRIs, there appeared to be some subtle increased vascularity that was not present on the initial MRI, suggesting that the AVM may have developed or matured after the haemangioblastoma resection. Removal of the haemangioblastoma could have altered flow dynamics in an interrelated AVM and caused an asymptomatic vascular lesion to mature into a clinically symptomatic AVM. Given the short time between tumor resection and presentation of AVM, de novo AVM although possible, appears less likely.

4. Conclusion

AVM and haemangioblastoma rarely presents together either temporally or spatially. Recent research supports both are of embryologic origin but require later genetic alterations to develop into symptomatic lesions. It is unclear in our case if the AVM was present at the time of the initial haemangioblastoma resection or developed de novo after tumor resection. More research is needed to elucidate the rare intermixture of these lesions.

Conflict of interest

None.

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Ethical approval

Cleveland Clinic IRB Office.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal, on request.

Author contribution

Bennett, E.E.—study concept/data interpretation/writing the paper, Kshettery, V.—study concept/data interpretation/writing the paper, Otvos, B.—writing the paper, Gonzalez-Martinez, J.—study concept/data interpretation/writing the paper /final editor.

Guarantor

Bennett, E.E., Kshettery, V., Gonzalez-Martinez, J.

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