

Ectopic arachnoid granulation involving a rare intracranial venous sinus variant

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[Received 19 July 2016; Accepted: 21 August 2016]

Arachnoid granulations are hypertrophied arachnoid villi, which extend from the subarachnoid space into the venous system and aid in the passive filtration and reabsorption of cerebrospinal fluid. These macroscopic structures have been described in various locations, with the transverse and sigmoid sinuses seen as normal variants on imaging.

Here we present the occurrence of an enlarged arachnoid granulation at the foramen rotundum where a variant intracranial venous sinus was identified during routine dissection.

Variations, such as the one described herein, should be recognised by those who operate or interpret images of the skull base. (Folia Morphol 2017; 76, 2: 319–321)

Key words: arachnoid granulations, intracranial venous sinus, foramen rotundum

INTRODUCTION

Pacchionian bodies or arachnoid granulations (AG) are cerebrospinal fluid filled protrusions from the arachnoid mater that extend from the subarachnoid space through apertures in the dura mater into the venous system [3, 4]. First described in 1705 and named after the Italian anatomist Antonio Pacchioni [4], these cerebrospinal fluid (CSF)-filled meningothe-lial-lined protrusions are distended arachnoid villi (AV) that function in filtration and reabsorption of CSF into the venous circulation [3, 4, 9]. Arachnoid villi are microscopic structures that when hypertrophied through increasing CSF volume and pressure, become arachnoid granulations, typically ranging in size from 2 to 8 mm allowing them to be viewed grossly [9]. While there is no consensus in the literature, arachnoid granulations that are greater than 1 cm or those large enough to fill the lumen of a dural venous sinus leading to local dilatation and filling

defects are termed giant AG [3, 4]. These extensions of the arachnoid can grow to expand the inner table of the skull, most commonly around the midline in the posterior frontal or anterior parietal area [3]. Herein, we present an unusual case of an enlarged AG at the site of communication between a rare intracranial venous sinus variant and the veins of the foramen rotundum.

CASE REPORT

During the routine dissection of a female cadaver (88 years at death), a variant intracranial venous sinus was identified on the left side (Fig. 1). The history of the specimen was that of hypertension, diabetes, and as a cause of death, left-sided heart failure. The sinus travelled from the superior orbital fissure posteriorly to the superior petrosal sinus. At the foramen rotundum and site of connection between the variant sinus and veins draining through the foramen



Figure 1. Cranial base of the cadaveric specimen reported herein. In the left middle cranial fossa floor, note the sinus of Kelch (left arrow) extending from the superior orbital fissure posteriorly to terminate in the superior petrosal sinus (not seen). The right arrow indicates the foramen rotundum.



Figure 2. Anteroinferior left skull base dissection. Note the large arachnoid granulation (arrow) extending into the foramen rotundum from an inferior view. The dura mater covering the floor of the left middle cranial fossa is retracted superiorly with forceps.

rotundum, an enlarged arachnoid granulation was identified (Fig. 2). The sinus size was approximately 6 mm anteriorly and the structure tapered posteriorly to a diameter of approximately 3 mm. The arachnoid granulation at the foramen rotundum measured 11 mm in diameter and protruded inferiorly into the foramen rotundum. No other intracranial anomalies or pathologies were identified in this specimen and no variant intracranial venous sinuses or enlarged arachnoid granulations were found on the right side.

DISCUSSION

Among the general population, approximately two-thirds have AG [9]. The prevalence and size of these structures increases with age in response to increased CSF pressure and volume from the subarachnoid space [3, 4, 9]. Historically, it has been postulated that the number and size of AG is an indication of CSF pressure [5]; however, recent research indicates that when CSF pressure is elevated, they are only secondarily involved in CSF absorption [5].

Ectopic AG have been described in various locations such as in the vicinity of the middle and posterior cranial fossae [7]. They often appear on imaging in the transverse and sigmoid sinuses suggesting normal anatomic variants [8]. The superior longitudinal sinus, cavernous sinus, superior petrosal sinus, middle meningeal vein, sphenoparietal and straight sinuses, are regions in which AG have been identified and documented [5, 6]. The features and various locations in which AG are found has led many investigators to include dural sinus thrombosis, meningioma, arachnoid cysts and many others in the broad differential for AG [4, 6, 9]. While initially described by Pacchioni over 300 years ago, AG are still poorly described, especially those residing in the middle cranial fossa [1].

In our case, the variant intracranial venous sinus represents an accessory sinus of Kelch described as passing posteriorly from the superior orbital fissure to drain into the superior petrosal or transverse sinuses. Hollinshead [2] has posited that the accessory sinus of Kelch and the ophthalmopetrous sinus of Hyrtl are identical although this latter sinus might also leave the skull anteriorly via the foramen ovale.

CONCLUSIONS

To our knowledge, an accessory sinus of Kelch, has never been reported to be related to an enlarged arachnoid granulation at the foramen rotundum. Those who operate or interpret imaging of the skull base should recognise the many variations and pathologies to be found, such as the one described in our case report.

REFERENCES

1. Chen F, Deng Xf, Liu B, et al. Arachnoid granulations of middle cranial fossa: a population study between cadaveric dissection and in vivo computed tomography examination. *Surg Radiol Anat.* 2011; 33(3): 215–221, doi: [10.1007/s00276-010-0733-2](https://doi.org/10.1007/s00276-010-0733-2), indexed in Pubmed: 20938775.
2. Hollinshead WH. *Anatomy for Surgeons: The Head and Neck.* New York: Harper & Row; 1968.

3. Kan P, Stevens EA, Couldwell WT. Incidental giant arachnoid granulation. *AJNR Am J Neuroradiol.* 2006; 27(7): 1491–1492, indexed in Pubmed: [16908565](#).
4. Keyzer BD, Bamps S, Calenbergh FV, et al. Giant arachnoid granulations mimicking pathology. *Neuroradiol J.* 2014; 27: 0, doi: [10.15274/nrj-2014-10047](#).
5. le Gros Clark WE. On the Pacchionian Bodies. *J Anat.* 1920; 55(Pt 1): 40–48, indexed in Pubmed: [17103914](#).
6. Leach JL, Meyer K, Jones BV, et al. Large arachnoid granulations involving the dorsal superior sagittal sinus: findings on MR imaging and MR venography. *AJNR Am J Neuroradiol.* 2008; 29(7): 1335–1339, doi: [10.3174/ajnr.A1093](#), indexed in Pubmed: [18417601](#).
7. Miyajima M, Arai H. Evaluation of the Production and Absorption of Cerebrospinal Fluid. *Neurol Med Chir (Tokyo).* 2015; 55(8): 647–656, doi: [10.2176/nmc.ra.2015-0003](#), indexed in Pubmed: [26226980](#).
8. Roche J, Warner D. Arachnoid granulations in the transverse and sigmoid sinuses: CT, MR, and MR angiographic appearance of a normal anatomic variation. *AJNR Am J Neuroradiol.* 1996; 17(4): 677–683, indexed in Pubmed: [8730187](#).
9. Trimble CR, Harnsberger HR, Castillo M, et al. “Giant” arachnoid granulations just like CSF?: NOT!! *AJNR Am J Neuroradiol.* 2010; 31(9): 1724–1728, doi: [10.3174/ajnr.A2157](#), indexed in Pubmed: [20581064](#).