Neurosurgical Forum

LETTERS TO THE EDITOR

Endovascular and surgical management of spinal dural arteriovenous fistulas

TO THE EDITOR: We studied with keen interest the article by Koch et al.² regarding their experience of open and endovascular treatment of spinal dural arteriovenous malformation (Koch MJ, Stapleton CJ, Agarwalla PK, et al: Open and endovascular treatment of spinal dural arteriovenous fistulas: a 10-year experience. *J Neurosurg Spine* 26:519–523, April 2017).

We commend the authors for their attempt to revisit this question in light of the emergence of new materials and technology of endovascular therapy. However, we would like to bring forth a few issues in this article that need further consideration. The authors have classified the outcome as “improved” and “not improved,” which fails to capture the extent of improvement after application of the two modalities. The study entirely misses the difference in efficacy of the treatment options in terms of the extent of symptom relief. Also, there is no mention of the duration of the follow-up period in their patients. Without knowledge of minimum follow-up period in the two groups, it is erroneous to compare outcomes considering the possibility of gradual relief of symptoms after treatment of spinal dural arteriovenous fistula (DAVF). Although the authors have listed the presenting symptoms of their patients, it would have been very interesting if they had noted the symptoms that preferentially improved in response to the two modalities of treatment and whether there were any differences between the groups. In their cohort there was a patient with headache as the only presenting complaint, whose outcome, if mentioned separately, would have been interesting to note. Outcomes of all the patients are known, and thus we conclude that no one was lost to follow-up. However, follow-up digital subtraction angiography or MR angiography in 4 patients was not done, but the authors did not mention the reason why.

The authors used two different embolizing agents, and prima facie there appears to be a difference in the occlusion rate, outcome, and need for retreatment between the two, but this difference was not been analyzed. Several comparative studies have established the superiority of Onyx (Medtronic) over 4 *N*-butyl cyanoacrylate (NBCA)

in terms of occlusion rate and efficacy;^{1,4} however, Onyx is associated with longer fluoroscopy and procedure times.⁶ It is interesting to note that these previous studies involved cranial DAVFs, and the observations are in contrast to those of the present study, in which NBCA seemed to be more efficacious. If NBCA is, in fact, found to have greater efficacy with shorter fluoroscopy time for spinal DAVFs as observed in the present study, it would prove to be a better embolizing agent overall.

The authors' concern for increased radiation exposure during endovascular treatment is noteworthy. The practical advantage of an endovascular procedure over surgery is better delineation of microvascular anatomy, but this comes with the risk of increased radiation exposure as discussed in the study and noted in 10 patients who received greater than 5 Gy of radiation. The cumulative effect of chronic radiation exposure poses significant occupational hazards to the interventionist. With the advent of indocyanine green videoangiography, better delineation of microvascular anatomy is possible, even during surgery, without the significant risk of radiation exposure to both treating surgeon and the patient.³ In fact, Takai et al.⁵ have found it to be useful in treating spinal perimedullary AVFs, even in cases of more complex microvascular anatomy, which actually underscores the fact that surgery is the gold standard and that a patient should be offered up-front surgery.

Finally, we would like to congratulate the authors on bringing forward an interesting and important question in light of new materials and technology; thus, this article lays the groundwork for a larger prospective study design involving an indocyanine green-based surgical arm and an embolization arm that will be better able to answer the pertinent questions about the primary treatment for spinal DAVFs.

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Disclosures

The authors report no conflict of interest.

Response

Foremost, we appreciate the insightful comments regarding our recent retrospective case series. The follow-up period ranged from 1 month to 2 years, and the median was 1 month. Unfortunately, formal postprocedural follow-up imaging, as noted, was not available in 4 patients, although they did attend follow-up in the clinic. Furthermore, we agree that more detailed follow-up with regard to specific symptom improvement is essential to parsing differences between open and endovascular intervention. Specifically, we initially sought to use established measures for the treatment of spinal AVFs with the Aminoff-Logue scale.¹ Yet when we performed our retrospective chart review, the data were presented in a more qualitative fashion, leaving us unable to provide this specific measure.

The patient who presented with headache was an 82-year-old woman with a cervical DAVF that presented with a hemorrhage, which was treated with open surgery. At follow-up she had no frank neurological deficits but had a mild persistent headache.

With regard to the difference between NBCA and ethylene vinyl alcohol (EVOH) outcomes, we agree that this presents an interesting point, especially given the authors' point about the intracranial experience. Preliminarily, we do know that the "cure" of these lesions relies on occlud-

ing the point of fistula between the penetrating arteries and the vein. A possible contributing factor could be the smaller nidus associated with spinal in contrast to cranial dural fistulas with a smaller pedicle feeder. EVOH relies on the formation of a plug to achieve forward nidal penetration and reaching the point of fistulization, which can be difficult in smaller segmental vessels. Conversely, because NBCA may not be as reliant on plug formation, it may be able to achieve sufficient penetration of the embolic agent. In our series, the use of one agent versus another seemed to be based on operator preference. Unfortunately, owing to our small numbers, we were unable to ascertain further details from the choice of embolic agent.

Finally, while we agree that surgery does provide a definitive option, endovascular interventions still retain a role in the treatment of these patients. Not all patients are optimal surgical candidates, and closure of the fistula can be achieved safely through endovascular embolization. We agree that the use of indocyanine green has aided open surgery, but at present it does not supplant the information obtained during angiography.

We are enormously appreciative for the interest in our study and similarly look forward to the continued evaluation and treatment of this rare disease in a more systematic prospective fashion in the future.

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Disclosures

Dr. Patel reports being a consultant for Penumbra and Medtronic-Covidien.

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