In Reply:

We appreciate the comments by Dr. Sanna regarding our article (1). We recognize Dr. Sanna has much experience with these tumors and that, as cranial base surgeons, we should work as
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a team of neurosurgeons, otologists, and occasionally, head and neck surgeons and plastic surgeons.

We also agree that one of the most important issues is the exposure and control of the internal carotid artery. We tailor the approach in terms of the retrojugular, transjugular, or infrajugular exposure with regard to the size and extension of the tumor. If the jugular foramen tumor is mainly intradural, we perform the combined transtemporal, transmastoid, and retrosigmoid intradural procedure for the resection of the intradural portion. If the jugular bulb is already occluded and the tumor has both intradural and jugular foramen components, we perform a combined intradural and extradural exposure. If the tumor is extensive, such as a glomus jugulare tumor involving the infrajugular component, infratemporal carotid artery, and jugular bulb, we do a combined transmastoid intralabyrinthine and combined transtemporal transjugular and infrajugular transcoccygeal and high cervical exposure. For extensive glomus jugular tumors, we always expose the high-cervical internal carotid artery for proximal control. We also expose the C7 infratemporal carotid artery in front of the jugular bulb by drilling the inferior bony tympanic ring and translocating the facial nerve anteriorly.

The most important aspect of cranial base surgery in this region is to avoid causing facial nerve palsy, swallowing disturbance, or voice hoarseness. We specifically choose to not reroute the facial nerve to avoid postoperative. We instead translocate the descending fallopian and stylomastoid foramen segments of the facial nerve approximately 5 mm anteriorly to provide adequate exposure of the infratemporal carotid artery. In our experience, it has not been necessary to reroute the facial nerve as Dr. Fisch recommends. Meticulous attention is given to preservation of the IXth and Xth lower cranial nerves around the carotid artery as well as the preservation of the pars nervosa of the jugular bulb floor. Our results from 53 cases of jugular foramen neuromas demonstrate that 75% of patients have normal or nearly normal swallowing function after surgery. For the 30 cases of glomus jugulare tumors, 64% of patients have normal or nearly normal swallowing function after surgery.

We perform either gross total or radical subtotal resection of glomus jugulare tumors. The patient may have some residual infiltration around the carotid artery in a minority of cases; however, we monitor the residual glomus tumor around the infratemporal high cervical carotid in follow-up examinations, and in many of these cases, the tumor shows no growth over a follow-up period of 5 to 10 years. If we see significant growth, the patient is referred for stereotactic radiotherapy or radiosurgery. Most jugular foramen tumors, neurinomas, meningiomas, or glomus jugulare tumors are benign. We do not recommend subadventitial dissection of the internal carotid artery because of the high risk of carotid rupture and other carotid complications.

In our experience of removing 30 cases of glomus jugulare tumors, we achieved gross total resection in 24 cases (80%), nearly total resection in 2 cases (6.7%), and subtotal resection (some tumor remains adherent to the pars nervosa or around the infratemporal internal carotid artery) in 4 cases (13.3%). New or worsened nerve deficit of the facial nerve was observed in 20% of the patients (most Grade II or III), and deficit of the IXth and Xth cranial nerves was noted in 27% of patients. Most of the patients with IXth and Xth cranial nerve deficit improved with thyroplasty procedures. There was no mortality in this series.

We thank Drs. Mario Sanna and Sean Flannigan for their valuable comments and appreciate the opportunity to clarify the rationale for our microanatomical joint neurosurgical-otolaryngological approach to lesions of this area.

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