cancer.³ In Chan and colleagues' series, there is close participation of surgeons, critical care specialists, cardiologists, endocrinologists, oncologists, and imaging physicians to optimize strategy.

So where do we expect the next surgical reporting for these rare tumors to progress? We already have access to meta-analyses to give us an understanding of the long-term outcomes after surgery for PCP.⁴ The results from this team are in keeping with what is known, recognizing the limited patient numbers in any series. Surgical teams with focused expertise have tremendous opportunity to pioneer new technologies to add to our understanding of rare diseases. We would hope that the next communication from this group will introduce the use of advanced imaging techniques to improve intraoperative outcomes, such as 3-dimensional printing of patient-specific heart models, providing surgeons with a hands-on experience of what to expect in the operation, and the ability to prepare for potential complications.⁵ With diagnostic imaging data, a personalized high-fidelity heart model can be created for patients with cardiac tumor with complex anatomy, helping determine surgical approaches by identifying surrounding structures at risk.^{6,7}

In summary, we applaud Chan and colleagues for their superb outcomes in the care for these complex patients and for defining the steps to reach such results: targeted referral with a dedicated multidisciplinary team with cardiac tumor expertise and conscientious preoperative planning. We look forward to their future accomplishments, with the rise of new adjuvant technologies being the focus of their next communication.

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Commentary: Resection of cardiac paragangliomas: All roads lead to Texas

Morgan Harloff, MD, Kareem Bedeir, MD, and Sary F. Aranki, MD

Cardiac paragangliomas are rare neuroendocrine tumors arising from chromaffin cells that can secrete catecholamines.¹ They typically present with atypical chest pain

From the Division of Cardiac Surgery, Department of Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Mass.

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Address for reprints: Sary F. Aranki, MD, 75 Francis St, Boston, MA 02115 (E-mail: saranki@partners.org).

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Morgan Harloff, MD, Kareem Bedeir, MD, and Sary F. Aranki, MD

CENTRAL MESSAGE

Cardiac paragangliomas are highly vascular, locally invasive, and difficult to resect. In experienced hands, however, resection can be safe and potentially curative.

and palpitations.¹ Complete surgical resection is the mainstay of therapy and often curative.¹ However, resection is a challenging endeavor because they are notoriously

FIGURE 1. Positron emission tomography (PET)–computed tomography demonstrating a 3.2-cm mass in the atrioventricular groove with intense dotatate uptake, consistent with a paraganglioma.

well-vascularized and locally invasive.¹ For these reasons, risk of intraoperative bleeding is high, and cardiopulmonary bypass is usually required for complex resection and reconstruction techniques. Mortality rates as high as 14% have been reported in the literature.²

In this edition of the *Journal*, Chan and colleagues³ present their 16-year experience with primary cardiac paragangliomas. This was a retrospective, single-center study designed to examine the management and outcomes for the treatment of cardiac paraganglioma when cared for by a multidisciplinary cardiac tumor team. With a cohort of 19 patients that underwent surgical resection, the authors report excellent operative mortality and long-term outcomes. Importantly, none of the patients had local recurrence.

This retrospective review is a well-designed and important study that has the potential to influence future management of cardiac paragangliomas. The authors are commended on their detailed follow-up and presentation of these positive results. However, there are some limitations that should be noted. First, as the authors acknowledged, this study is limited by the small number of patients as well as the retrospective and single-center design. Second, several patients lack demographic and preoperative characteristics. Third, several patients who were turned down for surgery elsewhere were referred to this well-established cardiac tumor program. Therefore, these results may not be representative of real-world outcomes.

We recently reported our experience with a primary cardiac paraganglioma in which a 59-year-old female patient presented with chest pain and palpitations.⁴ Plasma catecholamines and metanephrines were within normal

limits. Positron emission tomography–computed tomography demonstrated a 3.2-cm mass in the posterior left atrioventricular groove with intense dotatate uptake, consistent with a paraganglioma (Figure 1). En bloc resection was undertaken, including a portion of the coronary sinus with subsequent reconstruction with autologous pericardium. Pathology confirmed the presence of paraganglioma.

Currently, complete surgical resection remains the most safe and effective therapy for cardiac paragangliomas. Due to its rarity, a multidisciplinary team including a cardiac surgeon, oncology cardiologist, endocrinologist, and anesthesiologist should be involved. In the digital age, imaging studies can be easily forwarded to an experienced group with such expertise for valuable consultation regarding resectability and the best approach to pursue. In fact, our aforementioned case was extensively discussed with the senior author of this study, who has the most experience with the management of these rare tumors. We are very thankful for his insights.

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