Neck Pain Secondary to Post Radiation Fibrosis Managed With Ultrasound-Guided Adhesiolysis

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ABSTRACT

Background: Radiation therapy may result in complications, including fibrosis, which can result in pain and difficulty with movement – especially in the neck.

Case Presentation: A 52-year-old man with right-sided vague neck pain unresponsive to conservative management had a computed tomography scan that showed a vagal paraganglioma in the carotid sheath surrounding the right carotid arteries and internal jugular vein. Following radiation therapy, he noticed a new pain in his right jaw and neck worse with certain movements of the neck. Nonsurgical conservative measures including physical therapy and pharmacological management were unsuccessful. An ultrasound evaluation demonstrated fibrosis beneath the sternocleidomastoid muscle and in proximity to the carotid sheath. After careful trajectory planning using ultrasound imaging, a 25 G needle was introduced real time in proximity to the fibrosis. Using a dexamethasone/saline mixture under real-time ultrasound guidance, adhesions were released. After 3 injections, the patient reported greater than 90% pain relief, which lasted 4 months. Subsequently, he required similar injections approximately every 3 months to achieve greater than 75% pain relief.

Conclusions: This is a successful demonstration of the utility of ultrasound evaluation and guidance for adhesiolysis following radiation therapy.

INTRODUCTION

Paragangliomas are rare, highly vascular, benign neuroendocrine tumors arising within the paraganglia system located all over the body. Ninety percent of tumors are in the adrenal paraganglia, which are called pheochromocytomas, while only 3% of extra-adrenal tumors occur in the head and neck.[1] The most common head and neck paraganglioma is the carotid body paraganglioma. Vagal paragangliomas make up 5% of head and neck paragangliomas, are located at 1 of 3 ganglia, have a female predominance, and are more common on the right side.[1] They commonly present as a neck mass and are located within the carotid sheath, which includes the carotid artery and internal jugular vein.

Treatment options for head and neck paraganglioma traditionally have included surgery and/or radiation therapy (XRT). Because of speech (vocal cord paralysis secondary to vagus nerve resection) and/or swallowing difficulties post-surgery, surgery often is not considered as the first management option. While surgical intervention, including preoperative embolization, often has been the approach, recent improvements in diagnostic imaging and XRT have paved the way for cautious observation and nonsurgical intervention, including stereotactic radiation therapy.[1] The aim of surgical intervention is to achieve complete remission. XRT hopes to prevent disease progression, with local control achieved greater than 90% of the time after 5 years. Both surgical and XRT modalities may result in significant morbidity.[2] With the "wait and watch" approach, 40% of these tumors have remained stable.[1] According to Consensus Guidelines for Surveillance and Management of Metastatic and/or Unresectable Pheochromocytoma and Paraganglioma from the North American Neuroendocrine Tumor Society, XRT is the best studied option for patients with unresectable paraganglioma.[3]

Unfortunately, XRT is associated with multiple well-documented side effects that contribute to morbidity and decreased quality of life. In a study by the Rare Cancer Network that included

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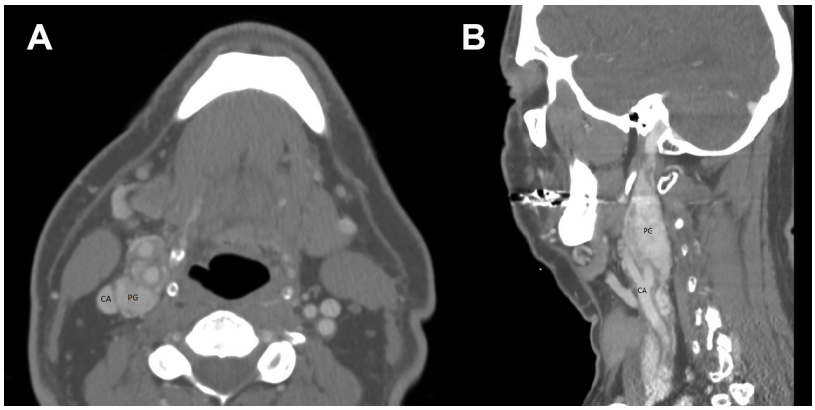
76 patients with head and neck paragangliomas who underwent XRT, the median age at diagnosis was 50 years, and local control was achieved in 90% of patients.[2] In our selected review of the literature, currently there is no documentation of any management options for the pain and secondary effects of radiation-induced fibrotic adhesions.

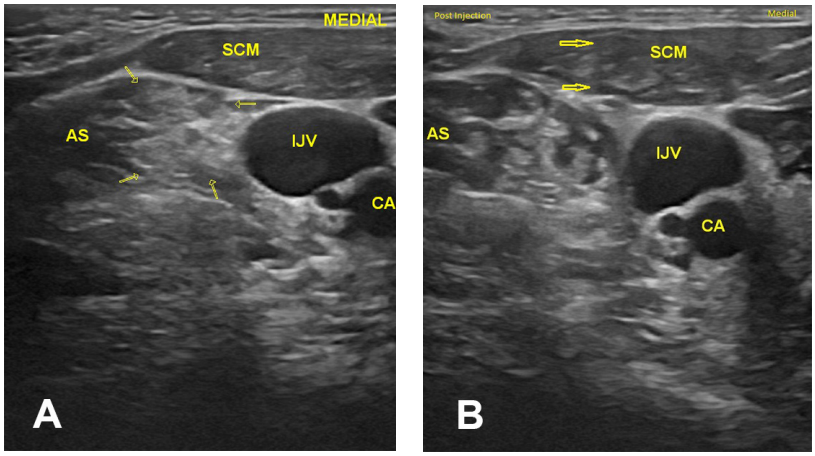
We report the case of a patient with significant neck pain following XRT for an unresectable head and neck paraganglioma, which was controlled following a series of ultrasound-guided release of adhesions.

Figure 1. Computed Tomography Scan of the Patient's Neck



A. Axial image showing the right carotid artery and paraganglioma.
B. Sagittal image showing the carotid artery and paraganglioma encircling the right carotid artery.

Figure 2. Ultrasound Images of the Right Side of Patient's Neck (A) Before and (B) After First Injection



Abbreviations: SCM, sternocleidomastoid; CA, carotid artery; IJV, internal jugular vein; AS, anterior scalene.
Thin arrows = post radiation fibrosis; thick arrows = out-of-plane needle.

CASE REPORT

A 52-year-old man presented to his primary care clinician for right-sided neck and right upper extremity radicular pain. His medical history was significant for Lewy body dementia, depression, posttraumatic stress disorder, type 2 diabetes, and hypertension. His symptoms were initially thought to be secondary to tensing his neck and arm muscles to control his tremor; therefore, he was started on cyclobenzaprine and referred to physical therapy.

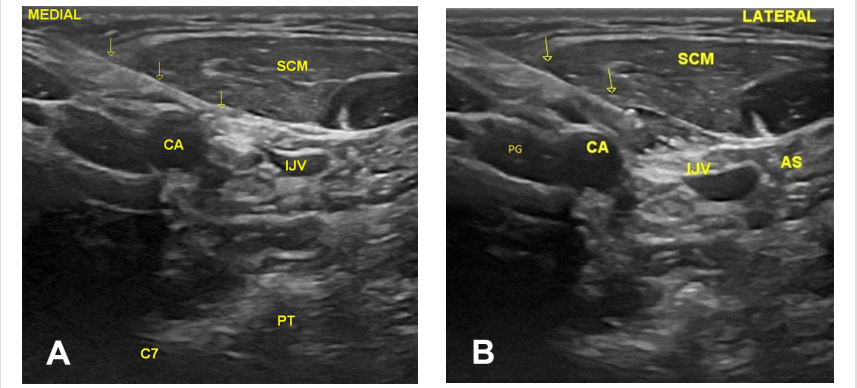
However, as his symptoms did not improve after 6 weeks, magnetic resonance imaging (MRI) of his cervical spine was performed, demonstrating a disc extrusion at C6-C7, small disc protrusions at C4-C5 and C5-C6, and a partially visualized right carotid mass. The mass prompted computed tomography (CT) imaging, which showed a mass in the cervical region compressing the right internal jugular vein and surrounding the right carotid arteries (Figure 1). Biochemical screening with 24-hour urine testing for catecholamines and metanephrines was positive for dopamine. Based on imaging and biochemical testing, a presumptive diagnosis of paraganglioma was made.

The tumor board recommended a "watch and wait" approach with repeat imaging in 3 to 6 months because of the morbidity associated with surgical and XRT interventions. A year later, the patient underwent a C6-C7 hemilaminectomy and discectomy, with relief of only his arm symptoms. Positron emission tomography (PET) scan performed 18 months after the start of his symptoms showed avid fluorodeoxyglucose uptake in the right-sided glomus vagale paraganglioma with no evidence of metastasis. Surgery was deferred as the tumor was within the carotid sheath with the potential for injury/damage to major vascular structures.

The patient underwent XRT. Immediately after its completion, he noticed a new constant pain in his right jaw and neck, a "pinching/choking" sensation in the midline neck, headache, xerostomia, and taste changes. Certain movements (turning to the opposite side) and positions of the neck made the pain much worse, including an inability to lay on either side affecting his sleep. Nonsurgical conservative measures, including physical therapy, stretching, and ice, as well as nonsteroidal anti-inflammatory drugs, did not significantly improve his pain.

He was then referred to the pain clinic for right-sided neck pain and headaches. On examination, he had exquisite tenderness to palpation over the sternocleidomastoid muscle (SCM). To ascertain the location of the pain in relation to the SCM muscle, in a

Figure 3. Ultrasound Images of the Right Side of Patient's Neck (A) Before and (B) After Second Injection



Abbreviations: SCM, sternocleidomastoid; CA, carotid artery; IJV, internal jugular vein; AS, anterior scalene; C7, cervical vertebra 7; PT, posterior tubercle of C7; PG, paraganglioma.

Arrows point to the in-plane needle.

Box. Complications Associated With Head and Neck Radiation Therapy

Xerostomia	Auricular problems/vertigo
Mucositis	Hearing loss
Trismus	Recurrent ear infections
Osteoradionecrosis	Dysarthria
Dysphagia ± feeding tube	Decreased vocal quality
Aspiration	Radiation induced fibrosis
Ageusia	Pain

maneuver like Carnett's sign, his head was turned to the opposite side, and he was asked to actively resist against pressure applied to his jaw, preventing him from turning his head This causes the SCM to be tensed, allowing for identification of the pain at or below the SCM (Shankar's maneuver). The pain was found to be deeper than the SCM, as he did not have any pain on palpation over the SCM when it was tensed. An ultrasound examination using a linear array transducer revealed significant hyperechoic areas between the SCM and anterior scalene muscles and in proximity to the carotid artery and internal jugular vein, suggestive of scarring or fibrous tissue at multiple locations.

The decision was made to release the adhesions using a large volume of steroid in saline mixture under ultrasound guidance. After informed consent, standard ASA monitors were applied, and an intravenous line was started. Using a linear array transducer, the area was scanned in both sagittal and axial views including color flow Doppler to plan a trajectory (Figure 2). Subsequently, a 25G hypodermic needle was advanced in an out-of-plane approach, and hydrolocalization using normal saline was used to locate the needle tip. Once appropriate fibrotic areas were accessed, 2 mL of solution was injected under real-time ultrasound guidance at 2 locations between the SCM and anterior scalene muscles in proximity to the carotid artery. The injectate contained 10 mg dexamethasone, 3 mL of normal saline, and 1 mL of 1% lidocaine. About a month later, the patient had a follow-up evaluation and reported that he had approximately 50% pain reduction that lasted about 5 days. He also endorsed ongoing improvement in baseline pain and noted that pain was rarely greater than 5/10. A similar injection was performed again under ultrasound guidance at other painful fibrotic areas, as we could not identify any fibrosis at the previous locations. This time the locations were accessible using an in-plane approach based on trajectory planning with color flow Doppler. He then followed up approximately 2 weeks later (Figure 3) and reported 90% pain reduction that was ongoing. He noted that pain was 2/10 that day, and the procedure was repeated this time closer to the paraganglioma to alleviate more of his pain.

At approximately 4.5 months, he started having neck pain again, and the procedure was repeated. He had 2 other episodes after that with good pain relief for approximately 10 weeks. He could not perform any physical therapy of his muscles due to his tremors, which may have prolonged the benefit. He insisted that we publish this report so that patients with similar complaints in his paraganglioma support group would also benefit. We obtained patient consent to publish this report.

DISCUSSION

A long-term side effect of XRT is radiation-induced fibrosis (RIF), which can result in functional impairment.[4] The most significant risk factors for RIF are treatment related, including both the total dose and dose per fraction of XRT, volume of tissue irradiated, and time course of treatment.[4] Other complications specific to head and neck XRT are listed in the Box.

As fibrosis progresses, pain and limited range of motion can develop, as seen in our patient. Our understanding of skeletal muscle injury following XRT is not very clear. Muscles with high glycolytic capacity have been shown to be most vulnerable for XRT-induced damage. Imatinib, simvastatin, enalapril, and dexamethasone are some medications that have demonstrated the ability to mitigate RIF pathology.[4] Fibrosis-causing adhesions has been a major cause for dysphagia following XRT, with almost 22% self-reporting swallowing difficulties.[5]

Adhesiolysis has been attempted and proved effective at multiple locations, including epidural and around peripheral nerves, scar tissues, and intraabdominal adhesions.[6] Surgical release has also proven successful for intrabdominal adhesions. Agents used for adhesiolysis include steroids, hypertonic saline, and hyaluronidase. Hypertonic saline injection can be painful; hence, local

anesthetics are added. Additionally, hypertonic saline can cause arrhythmias, pulmonary edema, ear pain, and hemiplegia. Besides being painful, hyaluronidase can cause anaphylactic shock.[6] Dexamethasone is a nonparticulate steroid safe for injection in highly vascular areas, as in our patient. If injected into carotid or, more importantly, vertebral artery, particulate steroids can cause major neurovascular injury, including paralysis. The 10 mg dose of dexamethasone is equivalent to 40 mg of depot methylprednisolone, which is commonly used for various injections including joints. The small amount of steroid added to the injectate potentially decreases inflammation and decreases further formation of fibrosis. However, steroids can cause various side effects, including bone demineralization, effects on glucose metabolism, and suppression of adrenocortical axis and, if given in large doses, may result in Cushingoid features.

In the few decades, the utilization of ultrasound imaging for needle guidance and bedside evaluation has increased tremendously. Ultrasound has multiple advantages, including lack of radiation, ability to visualize vascular structures and nerves, and portability. In addition, ultrasound guidance facilitates targeting in real time, helping to avoid critical structures in the vicinity. Although ultrasound imaging guidance has been utilized for release of scar tissue around peripheral nerves and intraoperative assessment during hysteroscopic adhesiolysis, challenging intermuscular adhesion release close to major vascular structures, as in our patient, has not been documented.[7] There is only 1 report of ultrasound-guided pressure injection of a large volume of steroid and local anesthetic anterior to the hip joint for release of scar tissue following arthroscopic repair of acetabular labrum.[8]

CONCLUSIONS

This report documents successful management of pain secondary to intermuscular adhesions secondary to fibrosis following XRT. Ultrasound imaging facilitated safe needle guidance and injection in an area surrounded by major vascular structures. Larger study of demonstration of ultrasound-guided injections is needed as RIF is widespread among those treated with XRT and can have a significant impact on quality of life.

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REFERENCES

1. Moore MG, Netterville JL, Mendenhall WM, Isaacson B, Nussenbaum B. Head and neck paragangliomas: an update on evaluation and management. *Otolaryngol Head Neck Surg*. 2016;154(4):597-605. doi:10.1177/0194599815627667

2. Lassen-Ramshad Y, Ozyar E, Alanyali S, et al. Paraganglioma of the head and neck region, treated with radiation therapy, a Rare Cancer Network study. *Head Neck*. 2019;41(6):1770-1776. doi:10.1002/hed.25611

3. Fishbein L, Del Rivero J, Else T, et al. The North American Neuroendocrine Tumor Society consensus guidelines for surveillance and management of metastatic and/or unresectable pheochromocytoma and paraganglioma. *Pancreas*. 2021;50(4):469-493. doi:10.1097/MPA.0000000000001792

4. Straub JM, New J, Hamilton CD, Lominska C, Shnayder Y, Thomas SM. Radiation-induced fibrosis: mechanisms and implications for therapy. *J Cancer Res Clin Oncol*. 2015;141(11):1985-1994. doi:10.1007/s00432-015-1974-6

5. King SN, Dunlap NE, Tennant PA, Pitts T. Pathophysiology of radiation-induced dysphagia in head and neck cancer. *Dysphagia*. 2016;31(3):339-351. doi:10.1007/s00455-016-9710-1

6. Yıldırım HU, Akbas M. Percutaneous and endoscopic adhesiolysis. Perkütan ve endoskopik adezyolizis. *Agri*. 2021;33(3):129-141. doi:10.14744/agri.2020.70037

7. Kriseman M, Schutt A, Appleton J, Pillai A, George V, Zarutskie PW. A novel ultrasound-guided technique for hysteroscopic adhesiolysis in high-risk patients. *J Ultrasound Med*. 2019;38(5):1383-1387. doi:10.1002/jum.14815

8. M V Reddy S, Ayeni O, Vatturi SS, Yu H, Choudur HN. Ultrasound-guided release of post-arthroscopy extra-articular hip adhesions in femoroacetabular impingement: a novel technique. *Skeletal Radiol*. 2021;50(12):2541-2548. doi:10.1007/s00256-021-03766-z

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