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# Cardiac Arrhythmias and CNS tumors: Cranial Radiation Induced Paroxysmal Atrial Fibrillation Status Post Resection of Glioblastoma Multiforme

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## ABSTRACT

Arrhythmias are quite common in patients diagnosed with cancer. Several etiologies have been identified which includes increased pro-arrhythmic effect of chemotherapeutic agents, immunological phenomenon from use of immunotherapy and the impact of ionizing radiation on organs in the body.

With regards to treatment, radiation to the chest wall for cardiothoracic malignancies has been implicated as having the highest frequency of occurrence for atrial fibrillation. Injury to the conductive system of the heart has been associated with this event. CNS malignancies such as glioblastoma multiforme have been predicted to increase risk of arrhythmias. This is even more pronounced after a craniotomy and brain resection. It has been hypothesized that alteration of neuronal circuits in the Central nervous system especially in the cardiovascular centers of the medulla oblongata could increase the release of catecholamines leading to tachyarrhythmias. Though more evidences are needed to support this, the coexistence of Paroxysmal atrial fibrillation and nausea in our patient after commencement of radiation further strengthens our view, as it is a well-known fact that the medulla oblongata houses both the chemoreceptor trigger zone for nausea/vomiting and the cardiovascular centers.

New onset Paroxysmal atrial fibrillation should be anticipated in patients with CNS malignancies that undergo brain radiotherapy. The risk of brain bleed from anti-coagulation is high especially in the immediate post-operative period. Nevertheless, monitoring for both symptomatic and occult atrial fibrillation is a sine qua non.

output by altering the activities of the vagus nerve.

We hereby present a case of a 61-year-old male with a left parietal mass, status post resection and histologically confirmed Glioblastoma multiforme WHO stage 4 with new onset Paroxysmal Atrial fibrillation after commencement of radiation.

## INTRODUCTION

Atrial fibrillation is the commonest cardiac arrhythmia and has been linked with several cardiovascular risk factors such as congestive heart failure, hypertension, Diabetes Mellitus and age. Structural changes in the

cardiovascular system from long term pressure changes or volume overload further increases the risk. As an example, there has been a strong positive correlation between left atrial size and incidence of atrial fibrillation.

The medulla oblongata which is a part of the brain stem houses the cardiovascular centers of the body. Through a series of complex neuronal networks, the central nervous system is able to modify the activities of the heart. Central Nervous System malignancies have been hypothesized to increase the incidence of atrial fibrillation. Nevertheless, the precise mechanism is not well understood more so the association of paroxysmal atrial fibrillation with commencement of either partial or whole brain radiation. It is suspected that radiotherapy may interfere with the normal functioning of these circuits by either increasing catecholamine surge and release or decreasing parasympathetic Cardiac Arrhythmias and CNS tumors: Cranial Radiation Induced Paroxysmal Atrial Fibrillation Status Post Resection of Glioblastoma Multiforme

## CASE PRESENTATION

Patient is a 61-year-old male with a history of essential hypertension, deep venous thrombus on IVC filter, left parietal glioblastoma multiforme status post resection and commencement of temozolomide. He presented with complains of nausea and palpitations of about a day's duration. He had no chest pain, light headedness or shortness of breath. A day prior to presentation, he had commenced radiotherapy with 1st fraction of 2 Gy radiation. On examination he was ill looking, had an irregularly irregular pulse, BP 124/90, Apex Beat 5 LICS MCL. He had an EKG which showed atrial fibrillation with rapid ventricular rate – HR 121 bpm (Figure1). Echocardiogram was essentially benign without left atrial enlargement or pressure changes. CT scan of the brain showed benign post-surgical changes without evidence of bleeding.

**Intervention**

Rate control was achieved with IV metoprolol 5mg with further transitioning to oral metoprolol 25mg twice daily. His CHADS2VASC score was 3 points with a history of essential hypertension, prior stroke and 4.6 % risk of stroke/TIA. Anticoagulation was contraindicated with recent brain surgery of about 2 weeks prior to presentation and thrombocytopenia. He was monitored on telemetry with spontaneous return to normal sinus rhythm after we achieved adequate rate control.

## DISCUSSION

The increased risk of atrial fibrillation in cancer patients has been documented in the literature with several mechanisms implicated [1,2]. Cardiotoxicity from chemotherapeutic agents and radiation treatment have been identified as major culprits [3,4]. While it is understandable the heightened risk of atrial fibrillation in patients undergoing radiation treatment for cardiothoracic malignancies, the association of cranial radiation with paroxysmal atrial fibrillation has not been explored in the literature.

Neuroanatomic connections occur between the brain and the cardiovascular system which helps regulate the activities of the heart. These requires a complex series of neuronal connections originating from the brain. Radiation treatment requires the use of intense high beam energy to kill cancer cells. The release of catecholamines during this process could increase the risk of tachyarrhythmias and cardiac damage leading to tachycardia induced cardiomyopathy [5]. Inhibition of parasympathetic out put is another possible mechanism. The vagus nerve which is the tenth cranial nerve originates from the medulla oblongata and innervates the SA

node and AV node. A lesion to this nerve from radiation treatment could lead to an imbalance between the parasympathetic and sympathetic system resulting in tachyarrhythmias. This risk is further increased in patients like ours that had a craniotomy for resection of an aggressive brain tumor. An insult to the brain from surgery has been theorized as a substrate for atrial fibrillation and to a much greater degree a secondary insult from radiation to an otherwise vulnerable organ.

Advancements in science and technology has helped reduce complications and enhance safety during radiotherapy. Some of these efforts include, using the smallest radiation dose possible, confining treatments to affected brain areas rather than whole brain radiation. With regards to dose and frequency of radiation, the incidence of atrial fibrillation when hypofractionation vs hyper fractionated therapy was used has not been compared in the literature.

## CONCLUSION

Cranial radiation increases the risk of atrial fibrillation. The occurrence is further increased with other associated risk factors such as CNS malignancies, post- surgical resection and other cardiovascular risk factors such as stroke, hypertension, CHF and diabetes. Stroke prevention in this population could be difficult because of increased risk of intracranial hemorrhage. Nevertheless, a high index of suspicion for atrial fibrillation is required in patients presenting with new onset palpitations or signs of hemodynamic compromise.