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Malignant Transformation Surrounding Iodine-125 Beads after Treatment of a Low-Grade Glioma

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Abstract

Permanent iodine-125 beads have been used in the treatment of low- and high-grade gliomas with good results. On computed tomography (CT) and magnetic resonance imaging (MRI), increased enhancement around these beads is common and is usually thought to represent radiation necrosis or disruption of the blood brain barrier. Further investigation of these areas of enhancement is warranted due to the rare possibility of malignant transformation occurring around these beads. Advances in radiological imaging, such as Fludeoxyglucose Positron Emission Tomography (FDG PET), have been useful in differentiating malignant transformation from benign entities. We present the first reported case of a 33-year-old lady with malignant transformation occurring around these beads approximately three years post-resection of a low-grade glioma.

Categories: Radiation Oncology, Pathology, Neurosurgery
Keywords: low-grade glioma, glioblastoma multiforme, iodine-125 beads, fdg-pet scan, malignant transformation

Introduction

Iodine-125 beads have been used in the treatment of low- and high-grade gliomas. They provide a cumulative therapeutic dose of 50-65 Gray within nine months. We present the first reported case of a 33-year-old lady with malignant transformation occurring around these beads approximately three years post-resection of a low-grade glioma.

Case Presentation

A 33-year-old lady previously underwent craniotomy and resection of a Grade 2 astrocytoma in 2003 in Germany. She was followed up with serial scans that showed no evidence of tumour recurrence. However, in 2007 a recurrence of the Grade 2 tumour was noted. A repeat craniotomy was performed in 2007 with the insertion of iodine-125 seeds. Regular follow-up was continued to ensure no recurrence, but she presented with absence seizures in June 2010. A magnetic resonance imaging (MRI) scan demonstrated enhancement of the right frontal region surrounding the areas of the previous radioactive seeds.

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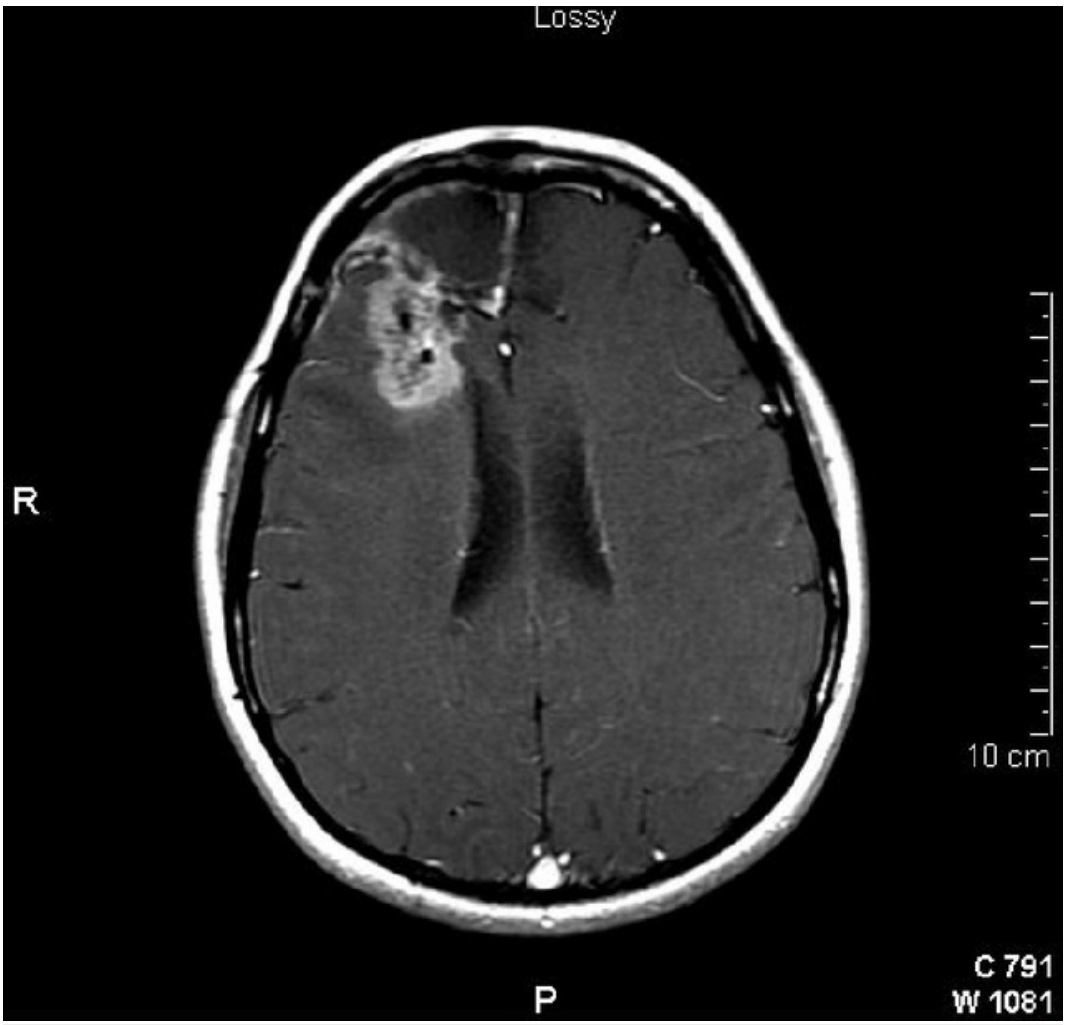

FIGURE 1:

Axial T1-weighted MRI with contrast demonstrates areas of contrast enhancement surrounding the implanted radioactive iodine beads.

It was unsure if these were changes in relation to radionecrosis or malignant transformation. A fludeoxyglucose positron emission tomography (FDG PET) scan was then performed which showed increased uptake in the enhancing areas, favouring malignancy over radionecrosis.

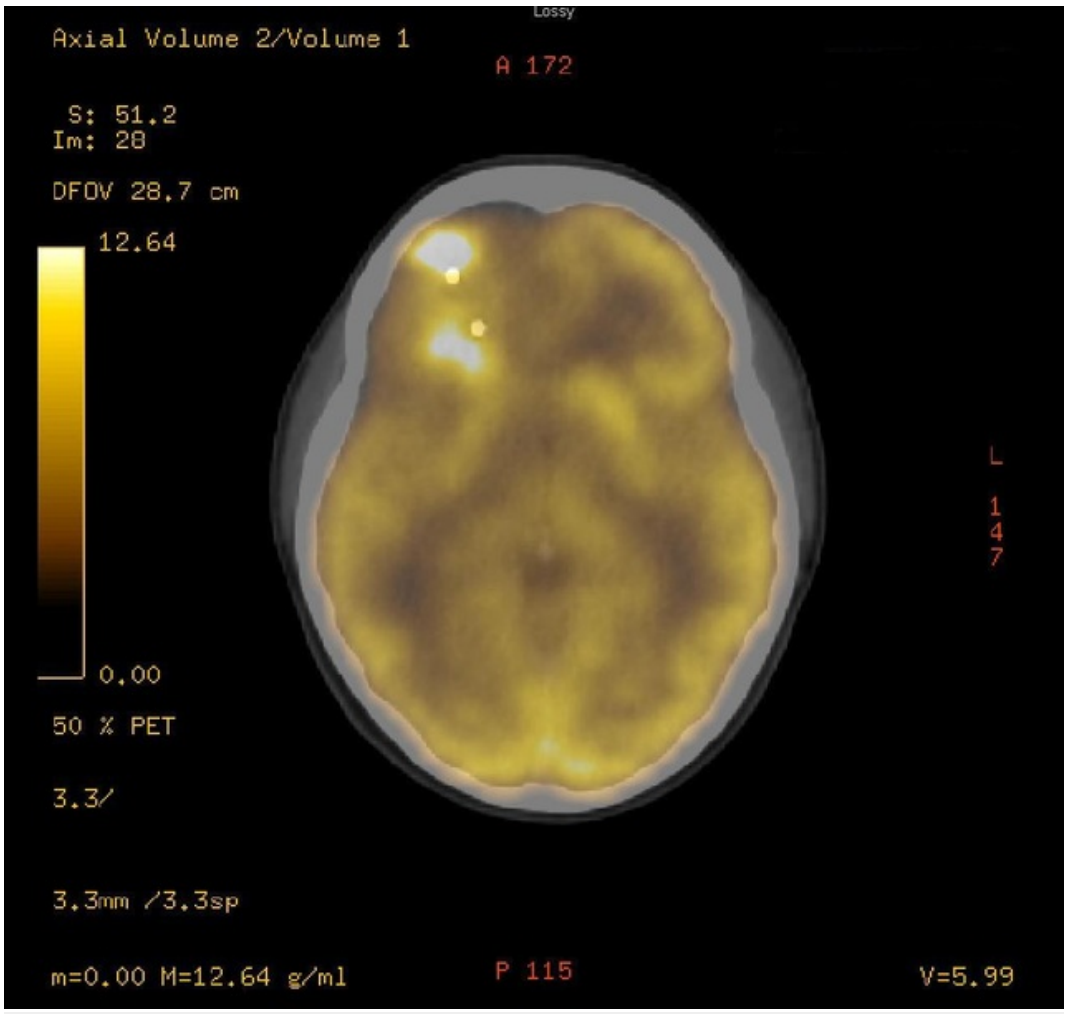

FIGURE 2:

FDG-PET showing increased radioisotope uptake in the areas of contrast enhancement on MRI

A craniotomy and resection of the right frontal tumour with removal of the iodine seeds was performed in August 2010. The seeds were examined by the nuclear medicine team, and there was no evidence of radioactive decay. Histology of the resected tissue confirmed glioblastoma multiforme.

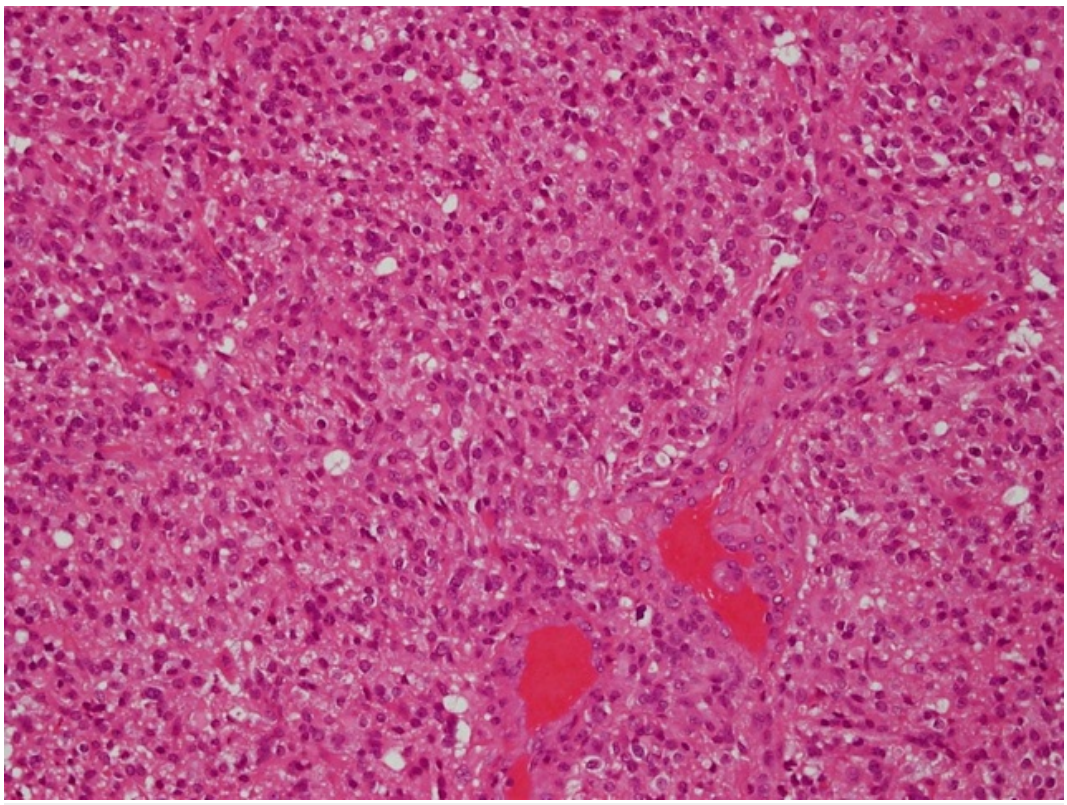

FIGURE 3:

Haematoxylin and Eosin stain X200. The tumour was composed of a densely cellular proliferation of mitotically active pleomorphic astrocytes with areas of vascular proliferation.

She subsequently underwent radiotherapy six weeks postoperatively (59.4 Gray over a period of six weeks) as well as chemotherapy with Temozolomide and did well. She unfortunately re-presented with absence seizures in June 2011 and an MRI scan at that time demonstrated a new right temporal lobe tumour. The previous resected area in the right frontal lobe did not have any convincing evidence of tumour recurrence. A right temporal craniotomy was performed to resect this new tumour and histology confirmed glioblastoma multiforme.

Discussion

Permanent iodine-125 interstitial implants gained popularity after being introduced in prostate cancer in 1965 [1]. These implants were superior to implants utilised previously in brachytherapy, such as radium [1]. The main benefit was in the elimination of radiation exposure problems, whilst achieving good cancer control [1]. Side-effects included radiation urethritis, rectal irritation and bleeding [1]. Iodine-125 brachytherapy is also commonly used for intraocular neoplasms [2]. It provides impressive ocular tumour control rates [2]. Whilst ocular side-effects are common, such as retinopathy, papilloedema and cataracts, there was rarity of associated secondary cancers [2]. These implants have also found a role in reducing the incidence of local recurrences and prolonging survival in non-small cell lung cancer [3]. From a brain tumour perspective, these implants have been used in the management of metastatic brain tumours since 1987 [4]. Results obtained demonstrated good survival and quality of life. Late complications included bone flap infection and CSF leak [5]. According to one study, the risk of symptomatic radiation necrosis is low [5].

Permanent Iodine-125 implants have also been shown to have similar survival benefits compared to temporary implants in patients with recurrent glioblastoma multiforme [6]. The added benefit was reduced rates of radiation necrosis and length of hospitalisation [6]. It may also improve the

long-term outcome if used in inoperable low grade gliomas [7]. Survival probabilities at five and 10 years were 97% and 92%, respectively, and a 25% tumour volume reduction was observed in more than half of patients [7]. Treatment-induced morbidity, such as radiation necrosis and vascular alterations, were low [7]. These seeds provide a cumulative therapeutic dose of 50-65 Gray within nine months.

In this case report, it is unclear if the malignant transformation occurred as a result of normal malignant progression of a Grade 2 tumour or as a delayed consequence of the iodine-125 implants. We feel that the latter is more likely as the malignant transformation occurred around the implants, as suggested by the MRI and FDG PET scans. However, it has been reported that residual traces of contrast enhancement around the implanted seeds may be observed as a result of treatment-induced local blood brain barrier disruption [7]. There have been no studies that distinguish this contrast enhancement being solely from this phenomenon or due to malignant recurrence or transformation. The FDG PET findings are useful in distinguishing these areas from radiation necrosis, although long-term follow up in these patients with permanent Iodine-125 implants did demonstrate a low risk of radiation necrosis [7]. FDG PET scanning may also demonstrate increased uptake in areas of local blood brain barrier disruption without the presence of a malignant tumour [5].

In this study, the presence of malignant transformation has been confirmed by histology. There does not seem to be any published literature about malignant transformation surrounding iodine-125 implants used in Grade 2 gliomas. On follow-up imaging of patients with low grade gliomas with iodine-125 implants, areas of contrast enhancement around the implants should be further investigated. FDG PET scanning should be initially carried out to differentiate radiation necrosis versus local blood brain barrier disruption or malignant transformation. If there is increased uptake of radioisotope in the areas of contrast enhancement, this should not be attributed solely to disruption of the local blood brain barrier. A low threshold for biopsy or resection of these areas of enhancement should be advocated to confirm histological diagnosis. Further studies in this area may be beneficial in determining if the rate of GBM transformation in previously known low-grade tumours is higher if radioactive iodine implants are used.

Conclusions

Patients with permanent iodine-125 interstitial implants for low-grade gliomas should be followed up with serial CT or MRI imaging. If increased contrast enhancement or uptake is noted around these beads, the use of FDG PET imaging should be considered as it may reliably distinguish malignant transformation from less serious entities. A low threshold for biopsy or resection of these areas of enhancement should be advocated to confirm histological diagnosis. Further studies may be useful in comparing rates of malignant transformation around these beads with normal malignant progression of a low-grade glioma.

Additional Information

Disclosures

Human subjects: Consent was obtained by all participants in this study.

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