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Facilitating transdisciplinary knowledge exchange about the diagnosis and potential treatment of Glioblastoma Multiforme (GBM)

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To cite this article: Anna Roberts, Mark Roughley & Caroline Wilkinson (2022): Glioblastoma: The Weed of the Brain, Journal of Visual Communication in Medicine, DOI: [10.1080/17453054.2021.2010521](https://doi.org/10.1080/17453054.2021.2010521)

To link to this article: <https://doi.org/10.1080/17453054.2021.2010521>



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Published online: 11 Jan 2022.



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Glioblastoma: The Weed of the Brain *Facilitating transdisciplinary knowledge exchange about the diagnosis and potential treatment of Glioblastoma Multiforme (GBM)*

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Introduction

In the changing landscape of medicine, cancer comes as a priority. 11,000 people are diagnosed with a brain tumour each year in the United Kingdom (NHS, 2020); however, only 1% of funding is attributed (Scott, 2021). 'Glioblastoma: The Weed of the Brain' is a research project that aims to engage audiences on Glioblastoma Multiforme (GBM), currently recognised as the most aggressive brain tumour in medical literature (Duma, 2016).

The tumour forms in the astrocyte cells that reside within the glial cells, found in the brain and spinal cord (Cancer research UK, n.d.). The tumour insidiously spreads through the white matter pathways within the brain (Duma, 2016) in a process known as angiogenesis; in which tumour cells invade healthy brain tissue and gain oxygen from blood vessel to increase its spread (Grisham, 2014).

This growth pattern attests to the tumours' complexity but also why no treatment has led to a successful prognosis. Current treatments have only sought to prolong the life expectancy from around 12 to 18 months (Methodist, 2019); through surgery, chemotherapy and radiation (Brem & Abdullah, 2017). These methods have proven harmful to brain cells and indicate a lack of acknowledgement for other methods, such as botany in medicine.

Could plants hold the potential for treating brain tumours?



Researcher, Tejas Athni, explores the potential of the Bacopa Monnieri plant to reduce the spread of Glioblastoma due to its anti-cancer property, Bacoside A (Athni, 2017). Before considering the

Bacopa Monnieri as an anti-cancer treatment, the plant was previously used within Ayurvedic medicine¹. The plant was considered an ancient herbal remedy to improve memory retention, thinking and cognitive skills, which attests to the plant's neurological capabilities. By understanding the medicinal nature of plants, we may be able to understand more about their effect on disease and the body. Merging botany and medicine in a transdisciplinary framework could facilitate novel treatments and ways of engaging with translational/scientific research; through knowledge exchange across disciplines; as discussed in the paper 'Transdisciplinary approaches enhance the production of translational knowledge' by, (Ciesielski et al. 2017).

In addition to the potential for a plant-based treatment for GBM, novel imaging techniques have been developed to augment visualisation of the tumour in the brain. One technique involves the optical imaging agent Gleolan, used in fluorescence-guided surgery (Gleolan. n.d.). After oral consumption of the solution before surgery, surgeons are able to locate tumour cells by shining an ultra-violet light over the patients' exposed brain, and revealing a glowing magenta colour to indicate the tumour site. This illustrates the efficiency of tumour resection by identifying the tumour site and possible spread (Henry Ford Health System, n.d.). These novel treatments further indicate the role of creativity within medicine.

'Glioblastoma: The Weed of the Brain'

The potential for nature as a source of treatment for GBM brings a wider discourse for public engagement and questions if art can facilitate this knowledge exchange of novel medical and botanical

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¹Ayurvedic Medicine dates back 4000 years ago and originated from India. It is considered a lifestyle and involves preventative treatment from diseases, which consists of various foods, spices and herbal formulas (Pole, 2009).

interactions. 'Glioblastoma: The Weed of the Brain' is a research project exhibited through the medium of sculpture and augmented reality, as a result of collaborations with Neurologists, Surgeons, Botanists, and Augmented Reality technologists. The aim of the exhibition is to use the medium of sculpture to explore and visualise parallels between GBM and the Bacopa Monnieri plant, in order to question what patterns in nature reside within us?

The role of chaos theory would argue that there are similar patterns in nature to the human body, such as leaf veins, plants roots which echo human blood vessels or neurons in the brain (Briggs, 2015). The exhibition generates a dialogue by illustrating the plants likeness to a tumour, through the patterning of the roots. However, the paradox here is, despite the plant functioning like a tumour, the Bacopa Monnieri's anti-cancer property illustrates the potential to harness nature for good and to heal the human body and mind.

Art/Science researcher and practitioner, Anna Roberts presents a series of sculptures, videos, installations and augmented reality enabled artworks to inform and engage the public concerning the role of nature in brain tumour treatment, but also how nature echoes human functioning. The exhibition consists of five pieces:

1. 'Angiogenesis (2021)' (Figure 4) a sculpture made from plaster of paris, a growing Bacopa Monnieri plant and coloured lighting.

2. 'Invasion (2021)' (Figure 5) combining a 3D printed brain and living Bacopa Monnieri plant.
3. 'Gleo-brain (2021)' (Figure 6) an Augmented Reality filter
4. 'Blooming Tumour (2021)' (Figure 7) a time-based bio-artwork composed of an agar sculpture and video time-lapse.
5. 'Crystal Universe (2021)' (Figure 8) a video piece and the poem 'What is Going on Inside your Mind?' (Figure 9).

The curation and exhibition were based on feedback from an online pilot exhibition, which determined the physicality of this exhibition within the X-Gallery at the Liverpool School of Art and Design building at Liverpool John Moores University. The sculptures, displayed triangularly within the space, allowed visitors to fully engage with the pieces through moving around and viewing the sculptures from different angles and heights, based on the varying plinth heights (Figure 1).

The augmented reality piece provided visitors an opportunity to engage with a visualisation of the human brain, while echoing the use of imaging devices in identifying GBM tumours, offering them a sense of control in their experience. The inclusion of coloured lights in 'Angiogenesis' (Figure 4), reflects the colouring of the Gleolan substance, as the tumour glows magenta against the purple light of the UV rays.

Using video and sound in the works offers a



Figure 1. Photograph of 'Gleo-brain (2021)', 'Angiogenesis (2021)' and 'Invasion (2021)' [photograph]. Image Courtesy of Anna Roberts ©.

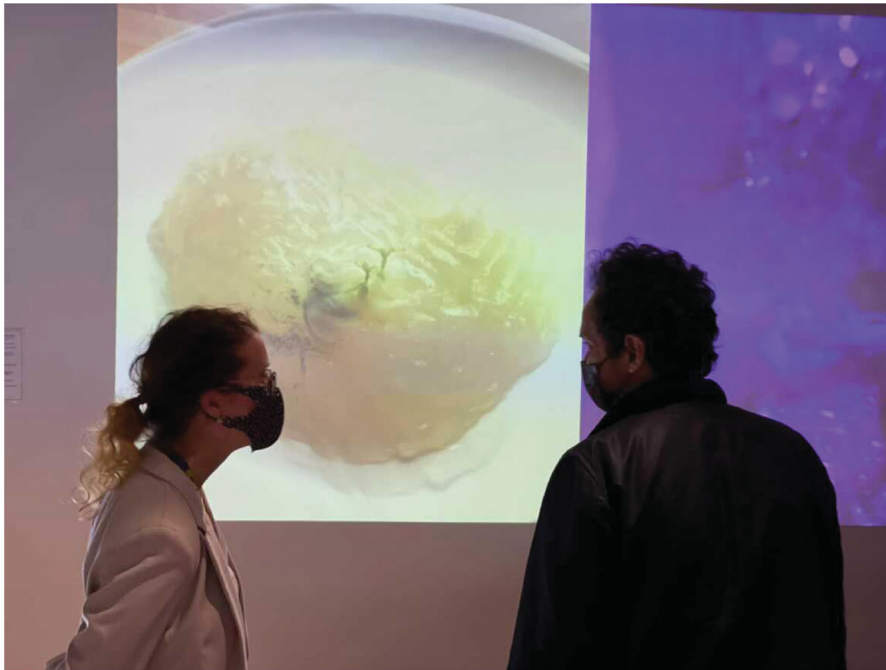


Figure 2. Photograph of Anna Roberts with Plastic Surgeon, Partha Vaide in front of 'Blooming Tumour (2021) and Crystal Universe (2021)' [photograph] Image Courtesy of Anna Roberts ©.

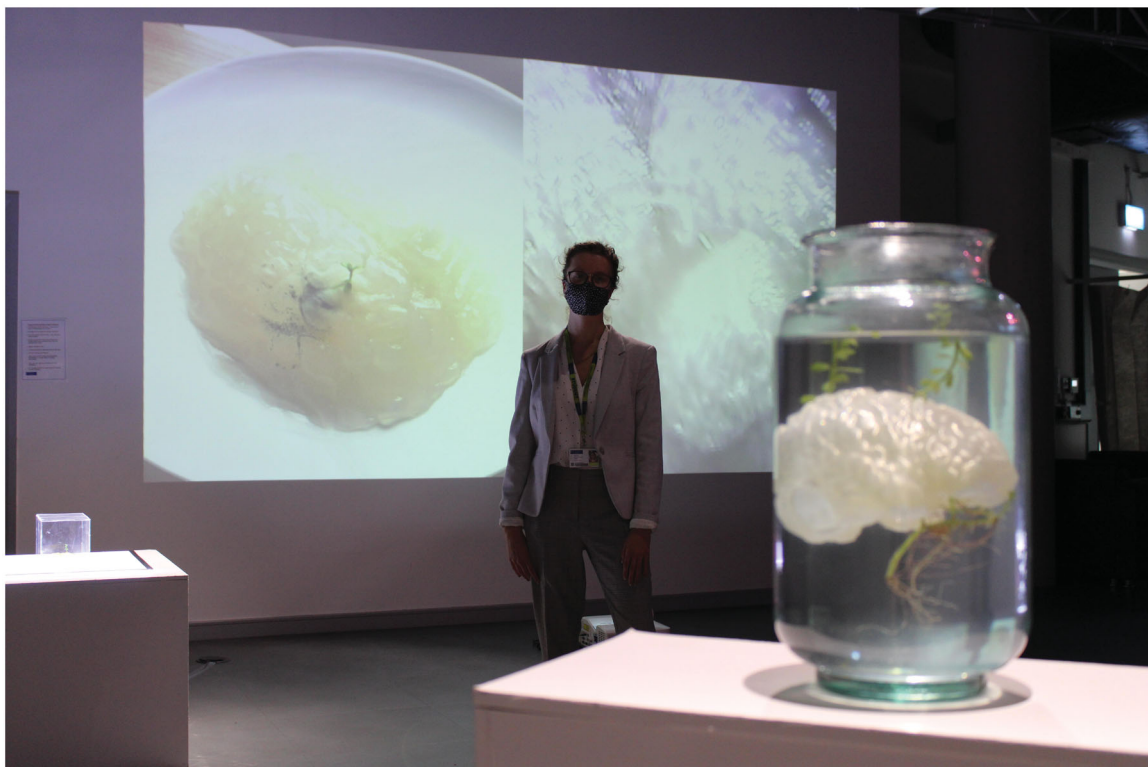


Figure 3. Image of Artist Anna Roberts standing with 'Blooming Tumour (2021)', 'Crystal Universe (2021)' and 'Invasion (2021)'. [Photograph] Image Courtesy of Anna Roberts ©.

multi-sensory atmosphere (Figure 2), that brings an empathetic and personal tone to illustrate the artists' experience with Glioblastoma Multiforme, as she was a young carer for her mother who passed away as a result of the condition.

This insightful collaboration and exhibition allowed Anna to form key connections with art and science disciplines. Her project communicated the

role of nature in GBM treatment, and how sculpture and augmented reality can visualise complex relationships and increase knowledge transfer of the diagnosis and treatment of GBM.

'Glioblastoma: The Weed of the Brain' was completed in partial fulfilment of Anna's Master's degree in Art in Science at Liverpool School of Art and Design, Liverpool John Moores University, and was

supervised by Mark Roughley and Professor Caroline Wilkinson.

To discover more about the project, visit the website here: <https://annarobrts.wixsite.com/website>

About the artist

Anna Roberts is an Art/Science researcher and practitioner from Cheshire, United Kingdom (Figure 3). Her current practice is sculptural and curatorial. Anna's interest in Art and Neuroscience led her to investigate diseases of the brain, specifically oncological research. Her personal experience with her mothers' diagnosis of Glioblastoma Multiforme (GMB), brings an empathetic perspective to her practice. Science communication is a particular area of interest, and this is explored through artistic experimentation and sculpture. Anna's previous works include written pieces

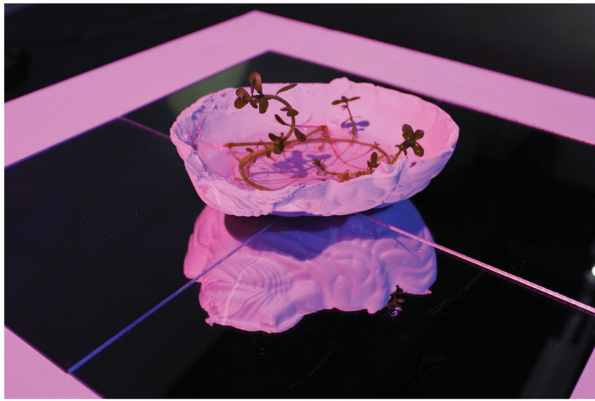


Figure 4. *Angiogenesis* (2021) [Plaster of Paris, Bacopa Monnieri, Mirrors, LED lights and coloured filters] Image Courtesy of Anna Roberts ©.

exploring Synaesthesia and the Neuropsychology of Facial Disfigurement.

Angiogenesis (2021)

'*Angiogenesis* (2021)' (Figure 4) evokes the insidious nature of Glioblastoma Multiforme through the root growth of a Bacopa Monnieri plant. The parallels in plant growth and tumour growth, echo to this pattern within nature. The term 'angiogenesis' refers to the formation of new blood vessels within the brain. This allows a tumour to retain a blood supply and invade healthy tissue for oxygen to grow. As we see the roots of the plant slowly grow and invade the empty space within the sculpture, we can understand how removing a tumour mass does not suffice. The role of lighting with this piece, further echoes imaging devices used to locate tumours, through incorporating similar colouring of the UV light and magenta glow of the tumour.

Invasion (2021)

'*Invasion* (2021)' (Figure 5) resembles the traditional methods of organ conservation in medicinal jars. The jar encases the 3D printed brain with a living Bacopa Monnieri plant entangling itself inside the vessel. The outgrowth of the Bacopa Monnieri plant allows the viewer to see the insidious growth pattern of Glioblastoma. Despite the similar growth pattern of the plant towards a brain tumour; the plant also resembles a sense of hope for brain tumour treatment, due to its anti-cancer properties. The light emanating from the brain, explores the idea of the brain as an



Figure 5. *Invasion* (2021) [Polyactic Acid 3D print, Bacopa Monnieri Plant and Recycled Glass] Image Courtesy of Anna Roberts ©.

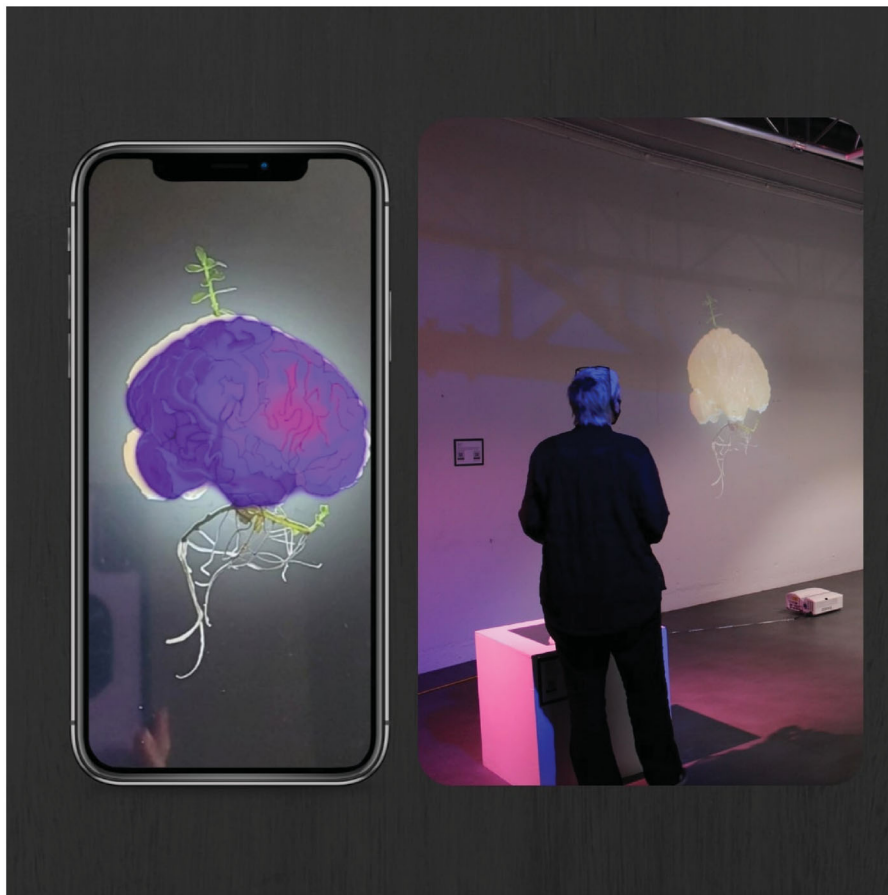


Figure 6. *Gleo-brain* (2021) [Augmented reality filter] Image Courtesy of Anna Roberts ©.

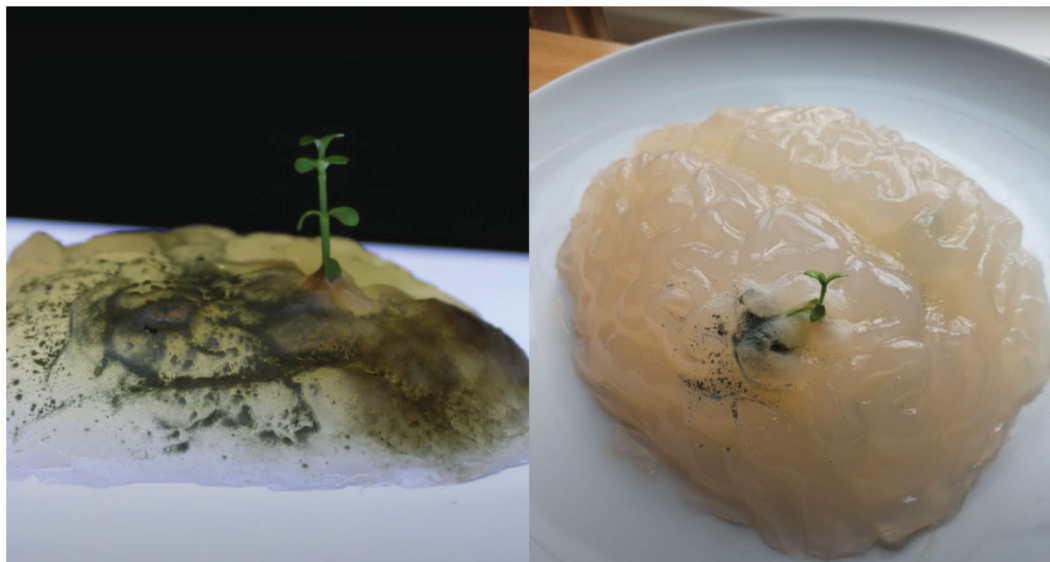


Figure 7. *Blooming Tumour* (2021) [Agar and Bacopa Monnieri Plant] Image Courtesy of Anna Roberts ©.

illuminated vessel, constantly active, but also the sense of hope from the plants anti-tumour properties.

***Gleo-brain* (2021)**

Based on research into intra-operative imaging, this augmented reality filter illustrates the ability

to image a tumours' location in the brain during surgery. The substance 'Gleolan' reveals the tumour with a magenta glow when using ultra-violet light. This piece allows visitors to image a brain tumour by mimicking intra-operative imaging, as conducted by medical practitioners during surgery.

Blooming Tumour (2021)

Encasing the *Bacopa Monnieri* plant in an agar, reflects the brain's viscosity as an adaptable and malleable organ. Here, the plant escaping from a sculpture of a brain and further echoes the uncontrollable nature of Glioblastoma as a tumour.

The gradual spread of mould echoes the pervasive symptoms involved with Glioblastoma Multiforme. Mould is seen as a visual indicator of disease and decay, this connection reflects the visual indicators of Glioblastoma such as headaches, paralysis and seizures.



Figure 8. *Crystal Universe (2021)* [Video Installation] Image Courtesy of Anna Roberts ©.

'The Blooming Tumour (2021)' (Figure 7) time lapse, illustrates the steady and insidious growth of the tumour, represented in the *Bacopa Monnieri* plant, along with the fast-spreading mould that encases the brain.

Link to video: <https://youtu.be/eEDxhbznXHk>

Crystal Universe (2021)

'Crystal Universe (2021)' (Figure 8) offers an intimate view inside a 3D printed brain, providing a viewpoint from a neurosurgeon's eye. The video explores the cavernous mystery within the brain, with the interesting patterning and texture. The hue and colouring of the video near the end of the piece, mimics the use of 'Gleolan' within intra-operative brain surgery, that reveals the tumour site.

Link to video: <https://youtu.be/KIHChOxTSsU>

'What is Going on Inside Your Mind? (2021)'

The poem that accompanies the 'Crystal Universe (2021)' (Figure 8) reflects the artists' personal experience of her mothers' diagnosis with GBM. The poem communicates the symptoms of Glioblastoma, such as seizures, paralysis, expressive aphasia and headaches. Through using poetry, it communicates an empathetic and engaging tone, by resonating with

Life does not wait for you,
It carries on with or without you,

I watch you lie in your chair as you stare up at the sky, shaking, foaming, screaming,
What is happening? What is going on inside your mind?

There is something inside of you,
Invading your brain,
Taking hold of your body,
Its roots wrap around every piece of your tissue, suffocating the life from you,

Magnets fill your brain, pulling you from side to side,
You are uncontrollable, yet controlled over this parasite.

Blue lights shine through,
Sirens roar,
Is this déjà vu? I have felt like this before, instead afraid of your life over mine.

Dizzying is this feeling,
Imagining this creature move insidiously through your brain pathways, planning its route
through the creases of your mind,

Helpless is this feeling,
Watching it take away your voice, your movement, your personality, with no ability to cease
its incessancy,

I must just watch and wait,
Watch and wait,
Watch and wait. |

Figure 9. *What is Going on Inside Your Mind? (2021)* [Poem, Audio recording] Image Courtesy of Anna Roberts ©.

visitors the traumatising experience of caring for a loved one with cancer.

Link to poem with video: <https://youtu.be/KIHChOxTSsU>

Disclosure statement

In accordance with Taylor and Francis policy and my ethical obligation as a researcher, I am reporting that my co-authors and I, have no financial or competing interests that may affect the research reported in the enclosed paper.

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