Medulloblastoma, a childhood brain cancer of the cerebellum, has one of the highest mortality rates of pediatric cancers. For over a century, scientists believed that medulloblastoma metastasized exclusively through cerebrospinal fluid; however, novel research reveals that it can also spread through the circulatory system. Understanding this new mechanism is critical for the development of therapies and to help affected families understand their child’s disease. An educational 3D animation was developed to effectively disseminate this research to the scientific community and to educate physicians, researchers, and affected families about this disease.

Introduction

The hematogenous route of medulloblastoma metastasis presents the first biological target for metastasis. Considering that metastases are the leading cause of treatment failure and death in medulloblastoma patients¹, the dissemination of this research is critical to the development of new therapies. The main problem is that the scientific community is largely unaware of this research. Additionally, scientific discoveries are often inaccessible to non-specialists, including patients and their families. Animation is an effective tool for disseminating research findings to the community and can be highly effective at increasing interest in scientific information². A variety of visual design strategies and storytelling techniques can be used to develop said animation.

Communication Objectives

1) Educate
   Compare metastasis via CSF vs. blood with an emphasis on the newly discovered route

2) Reduce Cognitive Load
   Use visual design strategies to improve learning outcomes and long-term memory retention

3) Establish Context
   Use of visual metaphor will put the research in context by establishing why this research matters, what the future implications are, and how it is relevant to the audience

4) Evoke Emotion
   Employ storytelling and cinematic techniques to evoke emotion and inspire the audience

Visual Design Strategies

Cinematic atmosphere
- Create realistic environments with anatomical accuracy
- Use of lighting and colour to establish the mood

Visuospatial contiguity
- Make verbal and visual components cohesive
- Use sound effects to make actions more convincing

Visual metaphor
- Use of metaphor to establish the context of this research
- Metaphor can help the audience relate to the material

Attention-cuing
- Make important object salient using colour, opacity, DOF, etc.
- Use of graphic elements such as arrows, boxes, and text

Colour-coding
- Use colour to help identify objects and achieve consistency
- Use a colour scheme to make the animation cohesive and add its own unique style

Representation style
- Create realistic elements to improve learning outcomes
- Use 2D elements at appropriate times

Narrative
- Develop a conversational narrative directed to the audience
- Record with high-quality equipment

Pacing
- Use system-pacing to increase learning outcomes
- Segment scripts to facilitate easy rearrangement

Evoking emotion
- Make it personal so the audience can relate
- Use music at key moments

Evaluation

The resulting animation is around 4 minutes in length and will be presented by SickKids Hospital at conferences, grant panels, and on the Taylor Lab website for physicians, researchers, and graduate students. It will also be uploaded to YouTube and Vimeo for educational outreach, non-profit use, and distribution to patients.

Results

Figure 3. Use of visual design strategies: cinematic atmosphere, representation style, and colour-coding. The brain was modelled using MRI data from the National Institute for Health (NIH). Real morphology data from NeuroMorpho were used to create accurate cerebellar neurons. Cinematic atmosphere was established using dramatic lighting, dust particles, and depth of field (DOF).

Figure 4. Use of visual design strategies: cinematic atmosphere, visuospatial contiguity, representation style, and colour-coding. Underwater sounds were used to enhance the feeling of being immersed in CSF in the leptomeningeal space. Tumour cells were coloured similarly so that it is easy to identify them; their nuclei were coloured differently to represent cancer heterogeneity.

Conclusions

I successfully developed a 3D animation to disseminate novel medulloblastoma research; this was achieved using various visual design strategies and linear storytelling. It serves as the first visual resource of its kind that educates a lay audience about the two mechanisms of medulloblastoma metastasis. Through the accurate depiction of anatomical and molecular structures, cinematic style, and innovative use of visual metaphor, a lay audience can effectively learn about this research and its future implications in the development of novel cancer therapeutics.

References

Bibliography


Funding

Acknowledgments

This study was supported by the Canadian Institutes of Health Research (CIHR) and the Canadian Children’s Cancer Society (CCCS).