Fluorescence Guidance Improves the Diagnostic Yield of Stereotactic Biopsy: A Proof of Principle Study

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Introduction

The incidence of primary and metastatic brain tumors is increasing. As systemic cancer therapies continue to improve, the incidence of small intracranial lesions found on routine screening is expected to continue to increase. Though metastatic brain lesions occur more frequently than primary brain tumors, ten percent of patients with a systemic cancer may present with a primary brain lesion. Treatments for metastatic and primary brain neoplasms differ, therefore it is often imperative to obtain a histopathologic diagnosis by direct tissue sampling. Stereotactic biopsy (STB) is the method of choice for sampling tissue from these lesions. However, this technique fails to obtain diagnostic tissue in 10-24% of cases. Failure to obtain diagnostic tissue delays initiation of personalized treatment plans and may result in further invasive procedures for patients. This project evaluates if coupling a novel in vivo optical imaging system with a STB system can verify acquisition of diagnostic tissue at the time of biopsy.

Microendoscope and Imaging

A fiberoptic imaging system was developed by coupling a 0.65mm diameter coherent fiber optic bundle to an Olympus FLUOView 1000 microscope. Human U251 glioma cells expressing blue fluorescent protein (U251-BFP) were visualized with fluorescein contrast in vivo and in vitro experiments. For animal experiments, a rodent was intracranial implanted with U251-BFP cells and administered fluorescein contrast 5 weeks post-implantation. A STB needle containing our 0.65mm imaging fiber was passed through a small cranial burr hole into the rodent’s brain. Fluorescence images from tumor and normal brain were obtained and quantitatively evaluated.

Methods

Fluorescein demarcated the location of tumor cells in vivo. In vivo, fluorescein fluorescence intensity was 71.2% greater from tumor regions compared to contralateral normal brain regions (1532.0 ± 52.47 vs. 895 ± 9.349 RFU, p<0.001). Increasing the diagnostic yield of stereotactic biopsies may expedite and improve the overall care of neuro-oncology patients. We found that fluorescence imaging during STB can provide direct visualization of neoplastic tissue in an animal brain tumor model. This technique may complement clinical STB systems by providing a simple technique for verifying neoplastic tissue during biopsy.

Results and Conclusions

Table 1.

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References


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