Enhanced cell killing in pancreatic adenocarcinoma cell line, BxPC-3, irradiated with a novel 2.5 MV photon beam using gold nanoparticles

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INTRODUCTION

Pancreatic cancer accounts for 2.7% of new cancer cases in men and 2.6% in women, and is expected to surpass breast cancer as the third leading cause of cancer related death in 2019 with an overall five-year survival rate of 8% [1]. Late stage diagnosis, high metastatic rate, and the proximity to critical organs contribute to the lethality of the disease. In this work, we present a potential to improve radiation therapy treatment of pancreatic cancer by showing the dose enhancement of gold nanoparticles irradiated with a novel 2.5 MV photon beam.

AIM

Radiation therapy is one of the treatment options for pancreatic cancer and the purpose of this study is to quantify the *in vitro* dose enhancement using gold nanoparticles (GNPs) in the pancreatic cancer cell line, BxPC-3, irradiated with a novel 2.5 MV beam compared to a clinical 6 MV beam.

METHOD

We compared the surviving fractions for a pancreatic adenocarcinoma cell line, BxPC-3, irradiated with 2.5 MV and 6 MV x-ray beams from a Varian Truebeam linear accelerator.

The cells were placed at 100 cm source-to-axis distance (SAD) and depth of 10 cm. The 2.5 MV beam is flat within 1% in the central 5 cm of the beam, and the cells were irradiated in 3.5 cm culture dishes to ensure irradiation uniformity. The cell dishes were embedded in a water equivalent bolus to ensure electronic equilibrium. Solid water was placed on top of the cells such that the cells were at depth 10 cm. Doses of 0, 1, 2, and 4 Gy were delivered to the cells with or without 10 μg/mL of GNPs.

The cells were counted and seeded after radiation and allowed to grow. After 14 days, the cells were fixed with ethanol and stained with methylene blue. Cell survival curves were created from surviving colonies.

Setup of the in vitro cell irradiation experiment.

RESULTS

The resulting surviving fractions of pancreatic cancer cell line, BxPC-3, irradiated with a novel 2.5 MV photon beam is shown in Figure 1.

The minimum dose enhancement in the cells with an injection of GNPs for 2.5 MV is 1.6 ± 0.3 for 2 Gy and the maximum is 2.3 ± 0.4 for 4 Gy. The uncertainties were calculated based on the standard deviation of the number of colonies counted from six repeated measurements.

The resulting surviving fractions of pancreatic cancer cell line, BxPC-3 irradiated with a clinical 6 MV photon beam is shown in Figure 2.

No significant differences in cell surviving fraction can be seen between cells irradiated in the presence or absence of gold nanoparticles.

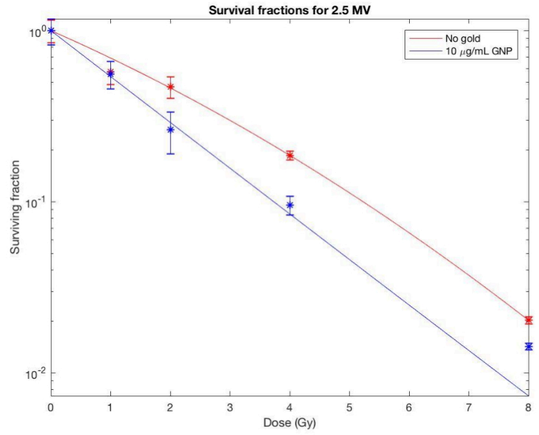

Figure 1. *Survival fractions for BxPC-3 cells irradiated with a 2.5 MV photon beam, with (blue) or without gold nanoparticles (red).*

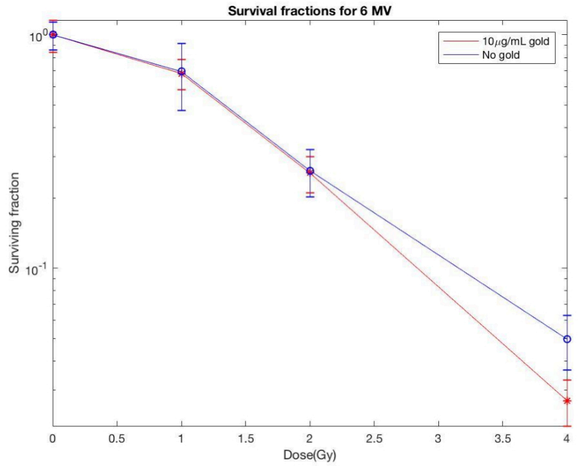

Figure 2. Survival fractions for BxPC-3 cells irradiated with a 6 MV photon beam, with (red) or without gold nanoparticles (blue).

CONCLUSIONS

This work demonstrates potential in dose enhancement in the pancreatic adenocarcinoma cell line, BXPC-3, using gold nanoparticles (GNPs) irradiated with a novel 2.5 MV x-ray beam as compared to a clinical 6 MV beam.

Dose enhancement of 1.6-2.3 can be seen in the pancreatic cancer cells irradiated with the 2.5 MV photon beam in the presence of 10μg/mL gold nanoparticles.

Surviving fractions of the pancreatic cancer cells irradiated with the clinical 6 MV beam is unaffected by the presence of gold nanoparticles.

ACKNOWLEDGEMENTS

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REFERENCES

[1] Canadian Cancer Statistics Advisory Committee. Canadian Cancer Statistics 2019. Toronto, ON: Canadian Cancer Society; 2019. Available at:cancer.ca/Canadian-Cancer-Statistics-2019-EN (accessed [Feb 27, 2020])

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