Pathologic Analysis of Ex-vivo Plasma Energy Tumor Destruction in Patients with Ovarian or Peritoneal Cancer

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ABSTRACT

Background: Cytoreduction of all visible disease has been associated with improved survival in patients with advanced-stage ovarian or peritoneal cancer. This is best achieved by minimizing injury to normal tissues. We report on the tumor destruction potential, in an ex vivo model, of a novel energy source that uses an electrically neutral beam of pure plasma to vaporize tissue.

Study design: Tumors were harvested from patients undergoing primary surgical cytoreduction for ovarian or peritoneal cancer. Specimens were divided into 1 cm³ sections and treated with pure plasma energy for 2 or 4 seconds using standardized power settings. Bright-field microscopy was used to measure the depth of tissue vaporization and lateral thermal damage (LTD).

RESULTS: The mean tissue vaporization depth was 2.7 mm ± 1.3 mm. The LTD was minimal at all tissue interaction settings (0.1 mm ± 0.03 mm). The LTD was approximately 5% of the depth of tissue vaporization. Tissue interaction time was increased from low settings to high settings, depth of vaporization increased by 0.6 mm (P=0.02) and LTD did not change. When power was increased from low settings to high settings, depth of vaporization increased by 0.6 mm, but adjacent thermal damage did not change. Depth of vaporization was more strongly correlated with tissue interaction time (r² = 0.40) than power (r² = 0.06). Tissue interaction time was 2.6-fold more powerful of a predictor of depth of vaporization than power setting.

CONCLUSIONS: Plasma energy can effectively vaporize ovarian and peritoneal cancer cells. Greater power and tissue interaction time results in more tumor vaporization while maintaining minimal LTD. This is an attractive characteristic of plasma energy that may be useful for eradicating tumor off of visceral surfaces.

OBJECTIVE

To describe the tumor destruction potential of pure plasma energy to vaporize tissue in an ex-vivo model.

METHODS

Specimens were collected from a single comprehensive cancer center from February to June of 2007 under Institutional Review Board (IRB)-approved protocols. Cases included 4 women found to have pathologically confirmed invasive high-grade serous ovarian or peritoneal adenocarcinoma. All cases had stage IIC or IV disease. Specimens were divided into 1 cm³ sections and treated with pure plasma energy using the PlasmaJet® (PlasmaSurgical, Roswell, GA) for 2 or 4 seconds using one of several standardized power settings at a distance of 1 cm.

RESULTS

Tissue vaporization depth varied from 0.9 mm to 6.1 mm (mean, 2.7 mm; SD, 1.3 mm). The lateral thermal damage overall was approximately 5% of the depth of tissue vaporization (Table 2). Both tissue interaction time and power were associated with depth of vaporization. When power was increased from low settings to high settings, depth of vaporization increased by 0.6 mm, but adjacent thermal damage did not change. Depth of vaporization was more strongly correlated with tissue interaction time (r² = 0.40) than power (r² = 0.06). Tissue interaction time was 2.6-fold more powerful of a predictor of depth of vaporization than power setting.

CONCLUSIONS

Plasma energy can effectively vaporize ovarian and peritoneal cancer cells. Greater power and tissue interaction time results in more tumor vaporization while maintaining minimal lateral thermal damage. An unexpected and remarkable characteristic of pure plasma energy is that as tissue vaporization increases, the lateral thermal damage remains relatively stable over a range of power settings and tissue interaction times.

SELECTED REFERENCES

Chi DS, Eisenhauer EL, Lang I, et al. What is the optimal goal of primary cytoreductive surgery for bulky stage IIIC epithelial ovarian carcinoma (EOC)? Gynecologic Oncology 2006;103: 559-64.
