Literature matters research bulletin

Dissemination of Melanoma Cells within Electrocautery Plume

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Following the introduction of laparoscopic cholecystectomy, it was hoped that this surgical approach could be applied to a number of intra-abdominal surgical interventions. Amongst others, the technique of colonic resection was developed and became popular with several surgeons. However, port site recurrences of the primary cancer loomed as a dark cloud over these generally encouraging results, leading to recommendation by some authors that laparoscopic colonic resection for malignant conditions be performed within the confines of controlled clinical trials only. Although the lower incidence of metastatic incisional recurrence in open surgeries may be due to a failure to report cases, the circumstances of reported cases led the authors to suspect that there are indeed physiological conditions specific to laparoscopy that promote port site recurrence.

One factor may be that cauterization of a tumor releases malignant cells within the electrocautery plume. Two observations lend support to this hypothesis. First, microscopic examination of the cautery plume reveals the presence of cellular and organic material in the range of 2 to 25μm, which is well within the range of living cells.[1] Second, the viability of some of this cellular debris has been shown by the identification and growth of viruses collected from the plume.[2,3]

Part 1: Identification of live melanoma cells in cautery plume:
Evaluation of viable tumor cells from the cautery plume was performed both in vitro and in vivo. The smoke was analyzed for the presence of viable cells by the tryptan blue assay and tumor growth by visual inspection for tumor colonies over a period of 6 to 8 weeks.

Part 2: Quantification of melanoma cells in cautery plume
In part 1 of the study, intact melanoma cells were identified in the immediate post-cautery period. The goal of part 2 was to objectively quantify the number of viable melanoma cells in the smoke aerosol. The mean number of viable melanoma cells was determined by linear correlation to the control tetrazolium (MTT) serial dilution assay. A negative control was obtained by applying cautery to plain white paper and bubbling the plume through the culture media.

Results
Large quantities of cellular debris were found in the smoke aerosols, consisting mostly of amorphous charred material and a few morphologically intact cells. Approximately 2,250 cells/well were measured from the 10 W cautery plume cultures. No viable cells were present in the negative controls smoke collection assay.

Comments
Intact viable melanoma cells were identified in the culture media immediately following smoke collection in part 1 of this study. The cautery currents were varied in the second phase of the experiment in order to determine their individual effects on cell viability. Although 5 minutes represents the upper limit of cautery time during surgery, persistent application at one site may raise local tissue temperature excessively and damage large quantities of cells.[1] In the second phase of the experiment, cautery application time was decreased to 5 seconds in order to simulate the short controlled bursts used in surgery and decrease thermal injury to viable melanoma cells. In part 2 of this study, viable cells in the plume aerosols were identified in quantifiable numbers 1 week after cauterization. Results of this study demonstrate that aerosolization of malignant cells occurs as a result of application of electrocautery to malignant tissues. This findings lends support to the hypothesis that the higher the incidence of port site recurrence of laparoscopic surgery for malignant disease may be due to implantation of cells in suspension within the electrocautery plume.

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