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**Targeted Light Therapy for Ovarian Cancer**

**Grantee:** Mingfeng Bai, PhD (need headshot)

**Institution:** Vanderbilt University Medical Center (North Central)

**Area of Focus:** Cancer Drug Discovery

**Grant Term:** 7/1/2017 to 6/30/2021

**The Challenge:** Most women are diagnosed with ovarian cancer at late stages, when tumors have spread toward the intestines, stomach, and liver. After surgery, tiny tumors are often left behind. Most patients develop a resistance to chemotherapy after their treatment.

For almost all ovarian cancer patients with an advanced stage disease, the cancer comes back an average of 15 months from diagnosis.

**The Research:** Since ovarian cancer doesn't typically spread throughout the body, Mingfeng Bai, PhD, is focusing on a treatment for just the abdominal area. His lab is making materials that bind to a particular protein that the cancer cells have a lot of, especially ones that chemotherapy doesn't work well on. When activated by light, the materials kill cancer cells.

Bai and his team are testing the effectiveness, safety, and dosing of the compounds on cells in the lab and then in mice as a proof of concept. There should be few side effects because:

* The light-sensitive material targets the tumor cells, while normal cells absorb far less.
* The activating light is only applied to the tumor area, and the light-sensitive material is non-toxic without it.

**The Goal and Long-term Possibilities:** If successful, Bai's phototherapy strategy could be used to "label" ovarian tumors and help guide removal surgery, then be activated in remaining tumor cells afterward to prevent recurrence. Or a patient could have chemotherapy before surgery with phototherapy treatment right after to treat leftover chemo-resistant tumors.

**ORIGINAL**

Ovarian cancer is one of the most deadly cancers in women because most patients are diagnosed at late stages when tumors have spread throughout the peritoneal cavity. Surgery and postoperative chemotherapy are the standard treatment methods in most ovarian cancer cases; however, tiny tumors are often left behind after surgery and most patients develop chemoresistance after chemotherapy. As a result, tumor recurrence happens in almost all the ovarian cancer patients with an advanced stage disease at an average of 15 months from diagnosis. To overcome these challenges, we propose to develop a light-based therapeutic technique to treat ovarian cancer in a target-specific manner. We will construct light-sensitive materials that preferentially bind to chemoresistant and chemosensitive ovarian cancer cells over normal cells, with especially high selectivity to certain chemoresistant ovarian cancer cells. Upon light activation, either during the debulking process or at a later time using an endoscope, this light-sensitive material will become toxic and destroy the ovarian cancer cells. This will target the residual tumors left behind after surgery and reduce recurrence. In addition, the proposed technique will allow for treating chemoresistant ovarian tumors, thus providing additional therapeutic value. Moreover, side effects will be minimal due to the dual-target effect: (1) the light-sensitive material targets the tumor cells with much lower uptake in normal cells; and (2) the light only applies to the tumor region and the light-sensitive material is non-toxic without light activation.

To apply the proposed strategy in the clinic, the light-sensitive material may be administrated either intravenously (into the blood stream) or intra-peritoneally (into the peritoneal cavity) before surgery. After accumulation in the tumors, the intrinsic fluorescence of the light-sensitive material will label ovarian tumors, and help guide the surgery. After large tumors are removed, the remaining tumor areas will be subjected to light irradiation for the treatment of residual tumors, which typically have both chemosensitive and chemoresistant ovarian cancer cells. Additional phototherapy treatments can be applied after post-surgical chemotherapy to treat chemoresistant cancer cells using an endoscope. Alternatively, patients can be subjected to chemotherapy before surgical debulking, and our phototherapy treatment right after surgical debulking can treat residual tumors where chemoresistance has developed. Therefore, if successful, our new phototherapy strategy may contribute to completely curing ovarian cancer patients in the long term.