

**Purpose:**To develop an image-guided pleural photodynamic therapy (PDT) treatment planning system for the purpose of achieving uniform distribution of light fluence, accurate light dosimetry, and better treatment efficacy.

**Methods:**A prototype of image-guided pleural PDT system has been developed. In this system, an infrared camera and corresponding tracking tools are used to locate the irradiation source positions during treatment. With pre-determined pleural cavity contour, light fluence distribution is calculated and displayed for the surgeon in real time. Preliminary results have been obtained using this prototype system in phantom and patients. This system has been tested with both 630 nm and 661 nm laser irradiation and HPPH photosensitizer.

**Results:**Cavity contour was successfully delineated using a contour wand and contouring software. The result cavity contour was compared with the CT contour of the phantom, and the RMS errors are less than 2 mm. A treatment simulation by this system was performed on the phantom. Accumulative light fluence was calculated in an unwrapped map to display the light fluence for each point of the cavity surface. The agreement between calculations and detector measurements is about 99% for a 90% confidence. This system has also been used to record PDT treatment data for three patients. The calculated light fluence has lower values than measurements (55.1% of the measurements), due to the lack of light absorption and scattering in the current model. From the patient results, PDT treatment light fluence was not evenly distributed on patients' pleural cavities and may include maximum deviation of about 20 J/cm<sup>2</sup>, according to the current protocol.

**Conclusions:**This work indicates that current detector-guided pleural PDT treatment may induce non-uniformity in light fluence distribution. From the preliminary results, the image-guided pleural PDT treatment planning system showed the potential for better PDT treatment guidance efficacy.

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