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The role of ultrasound and photoacoustic imaging in laser therapy of cancer

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Laser therapy is an alternative cancer treatment approach when traditional surgery cannot be used to remove small, poorly defined lesions embedded within vital organs. For example, in photothermal laser therapy, a localized temperature increase to cause tumor necrosis is achieved by using a continuous wave laser and molecular targeted and optically tuned photoabsorbers. However, for laser therapy to be successful, it is necessary to identify the presence of photoabsorbers in the tumor prior to therapy, to monitor the spatio-temporal temperature changes during therapy, and, finally, to identify thermal/mechanical damage and tumor destruction after therapy. To guide laser therapy, we developed a combined ultrasound/photoacoustic imaging system and bioconjugated nanoabsorbers. In our approach, ultrasound imaging is utilized to identify the anatomy of the tumor while photoacoustic imaging is used to ensure the presence of targeted nanoparticles before therapy. Both ultrasound and photoacoustic imaging techniques are then used to monitor temperature during therapy, ensuring tumor necrosis and protection of the surrounding healthy tissue. Finally, ultrasound and elasticity imaging is used to confirm thermal damage and cancer destruction. The results of our studies indicate that photoacoustic and ultrasound imaging can be used to effectively guide laser therapy.