The history of technology development from pioneering to recent advancements in clinical applications of photoacoustic imaging has been significant. In the last decade of the 20th century, the field of photoacoustic imaging has made substantial progress, with several reports and reviews highlighting the potential of this technology in various medical applications. The advancements have been primarily driven by the use of short-pulse laser excitation, which has led to higher resolution and contrast images of biological tissues.

Photoacoustic imaging, as referred to as optoacoustic imaging, has a long history of technological development and has gone through several phases of growth and expansion. In the early stages, the technology was primarily used for research purposes. However, in recent years, the field has evolved, and the technology has begun to make its way into clinical settings. The translation of this technology from the lab to the clinical setting has been a gradual process, with several challenges to overcome.

However, the clinical applications of photoacoustic imaging are predominantly in the detection, diagnosis, and treatment monitoring of vascular diseases. The technology has been shown to provide high resolution and high contrast images of blood vessels, which can be used to identify changes in the vasculature, such as in cancer and inflammation. Additionally, with spectroscopic photoacoustic imaging, it is possible to estimate the blood oxygen saturation, which can provide information regarding the metabolism of embedding tissues that can serve to provide more information to help make a robust diagnosis.

Recent advancements in photoacoustic imaging have led to the development of novel devices and methods. For instance, the use of high-frequency ultrasound transducers has improved the resolution of images. Furthermore, the development of faster and more efficient algorithms for image reconstruction has been crucial in translating this technology to clinical use. The availability of portable systems has also been essential in making photoacoustic imaging more accessible to clinicians.

Clinical photoacoustic imaging results indicate that a higher number of VBPs might be a biomarker for primary breast cancer. In their original article, Oraevsky et al. describe technical details and examples of patient breast images obtained with a clinical optoacoustic ultrasound system based on a hand-held probe utilizing a linear-array of ultrawide band ultrasonic transducers. Clinical images obtained using the ultrasound/optoacoustic system in a multicenter clinical trial demonstrate vascular patterns, microvascular density and relative values of the total hemoglobin and blood oxygen saturation in tumors. This additional functional information enables increased accuracy of radiologist assessment of malignancies compared with sole use of ultrasound.

Jo et al. [6] review the technologies and the studies focused on musculoskeletal imaging and inflammation detection in humans. The authors conclude that the patient results suggest that diagnostic information available from photoacoustics could be similar or better compared to the current imaging technologies. The important advantages of the method are its non-invasive and non-ionizing features, excellent soft tissue contrast, high sensitivity to blood volume and blood oxygen saturation, and its small footprint lending itself to use as a point-of-care device. Van den Berg et al. [7] present an original article where they evaluate a portable ultrasound/photoacoustic imaging system for the feasibility of assessment of clinically evident synovitis in rheumatoid arthritis. The interphalangeal joints of 10 patients and 7 healthy volunteers were scanned using the system. The authors found a 4–10-fold increase in photoacoustic response between inflamed and non-inflamed joints which is a first step toward the application of photoacoustics for diagnosis and monitoring of inflammation in peripheral joints. The original article from Aguirre et al. [8] also deals with photoacoustic imaging of fingers, this time under the nail-folds where three-dimensional images of the deeper arterioles and venules are obtained. They describe the use an ultra-wideband raster-scan optoacoustic mesoscopy (UWB-RSOM) system which is able to quantify capillary density and capillary diameter as diagnostic features that can relate to systemic sclerosis.

Merçepe et al. [9] present in their original article, a hybrid approach using a hand-held multi-segment detector array that enables multimodal spectroscopic optoacoustic, pulse-echo ultrasound and color Doppler imaging. In a healthy volunteer, the authors demonstrated oxygenation status of structures located at depths of at least 1–2 cm, such as the carotid artery, the sternocleidomastoid muscles, the thyroid lobe and the jugular vein. Such an integrated approach could contribute to a more reliable assessment of the severity of carotid artery disease.

All papers in this special issue have undergone a rigorous peer review process, and we are grateful to the reviewers for their efforts in ensuring that the Photoacoustics’ high standards for quality and integrity were met. We are grateful to Prof. Dr. Vasilis Nezichristos (Former Editor-in-Chief) for initiating this Special Issue. Further we
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