Quantitative Usage of a Novel Bioelectronic Chip for Noninvasive, Versatile Cancer Diagnosis

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Though accurate, current cancer diagnostic methods are time-consuming, expensive, disease-specific, and qualitative. To improve clinical cancer treatment, a better quantitative system for early diagnosis is desirable. Matrix metalloprotease (MMP) is an endopeptidase upregulated in urine from cancer patients. Thus, detecting overexpressed urinary MMP can suggest tumor presence in humans. For a rapid point-of-care detection method, literature was reviewed and preliminary results were collected to construct a novel bioelectronic chip sensitive to MMP. Through multiple iterations, the bioelectronic chip was optimized for maximum conductivity and, thus, sensitivity in urine. Later, Western analysis was used to indicate minimal cross-reactivity in the chip, and zymography was used to validate MMP presence in urine from cancer patients. Initial tests then used the bioelectronic chip to confirm a dose-dependent curve and minimal cross-reactivity with IgG. Following tests used the chip to test urine populations from types of cancer and non-cancer patients, always revealing $P<0.05$ differentiability of populations. ROC analysis using zymography as a control determined the chip to be 14% more accurate than ELISA. Consequently, a novel bioelectronic system has been developed to quantitatively detect tumors of various cancer types non-invasively, rapidly, and inexpensively. Thus, early cancer diagnosis can lead to more effective cancer treatment and save many lives.

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