Early Cancer Screening with P-Scan technology

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Cancer and Diagnostics Market

- Cancer is still the 2\textsuperscript{nd} leading cause of death worldwide.

- Total US costs for cancer treatment $129B (NIH estimate)

- Number of Americans diagnosed with cancer each year is 1.5M

- Each year over 500,000 people in the US die from cancer (one every minute)

- Lung, colorectal, breast and prostate account for 53\% of all cancer deaths

- “A key challenge in cancer control and prevention is detection of the disease as early as possible…”  P. Srinivas

- Since an effective way to cure cancers has not been found, early detection becomes an important alternative.

- Cancer Diagnostics worldwide market estimated at $7.4B in 2009

- Tumor marker segment expected to reach $2B by 2010 and grow at 8-10\% into the foreseeable future

- PSA marker for prostate cancer alone accounts for $400M
Introduction

• Research Goal
  – To develop a rapid, sensitive non-invasive technique to detect biomarkers that indicate whether or not an individual has cancer at the earliest possible point.
  
  – Biomarkers are compounds in the body that can be indicative of medical conditions or biological states.

• Examples
  – Tumors
  – Proteins & peptides
  – Hormones
  – Small molecules
  – DNA
Pteridines

- Pteridines: A group of heterocyclic compounds containing a wide variety of substitutions on the basic compound pterin

- Pteridine: A class of compounds excreted in the urine, whose levels are found to elevate significantly in tumor related diseases

- Pteridines are believed to exist in the body in predetermined levels that are indicative of a healthy individual. We hypothesize that changes in these levels indicate that the body was being attacked by cancer.

- Different cancer types are believed to give unique fingerprints that differ from a non-cancer patient and will even provide fingerprints whose levels will correlate with the severity of the cancer in the body.
Instrumental Setup

- Laser
- 2 cm Focal Lens
- Capillary Electrophoresis
- B.P. Filter
- Iris
- Cutoff Filter with Confocal Lens (43x)
- PMT
- I to V Converter
- A/D Converter
- CPU

Gibbons S., Stayton, I., Ma, Y., *Electrophoresis* 2009 submitted
Features of the Instrumental Design

• Due to the unique design of the instrument, it has:
  – Very high sensitivity
    • \( \sim 1.0 \times 10^{-11} \text{M} \) (detection limit)
  – Good reproducibility
    • \(< 8\% \) RDS for multiple injections over multiple days
  – Low noise
    • \(< 1\text{mV} \)
• Easy to operate
• Can be upgraded for automatic analysis and data output
Standard & Sample Injection

1) 6,7-dimethylpterin
2) 6-biopterin
3) D-(+)-neopterin
4) 6-hydroxymethylpterin
5) Pterin
6) Isoxanthopterin
7) Xanthopterin
8) Carboxypterin

Final Parameters
pH: 9.63±0.02
EP: 26kV
1 to 10: Breast Cancer Urine Samples
11 to 29: Normal Urine Samples
1 to 11: Lung Cancer Urine Samples
12 to 29: Normal Urine Samples
Cancers we have studied
- Breast Cancer
- Breast Cancer with Mets
- Lung Cancer
- Fallicular Lymphoma
- Colon Cancer
- Ovarian Cancer
- Non Hodgkin’s Lymphoma
- Rectal Cancer
- Bladder Cancer
- Pancrate Cancer
- Esophageal Cancer

1 to 38 All 11 Cancer Urine Samples we have studied
39 to 55 Normal Urine Samples
1 to 38 All 11 Cancer Urine Samples
39 to 55 Normal Urine Samples
Series 01 : Isoxanthopterin    Series 02 : Xanthopterin
1. 6,7-Dimethylpterin, 2. 6-Biopterin, 3. Neopterin, 4. Hydroxymethylpterin, 5. Pterin, 6. Isoxathopterin, 7. Xanthopterin

Nov 19, 2005 Standard, Cancer, Non-Cancer Urine for Pteridine Study
1. 6,7-Dimethylpterin, 2. 6-Biopterin, 3. Neopterin, 4. Hydroxymethylpterin, 5. Pterin, 6. Isoxathopterin, 7. Xanthopterin

Nov. 21, 2005 Standard, Cancer, Non-Cancer Urine for Pteridine Study
• Oncopterin – It has presented itself as a potential indicator for a positive / negative test for cancer.
  – It was discovered that only oncopterin was observed in cancer patients where it was not detectable in normal people.
  – We plan to synthesize the oncopterin at Missouri S&T and test both control and patient samples for the presence of this new discovery.
Current system achieves these goals

1. A specific instrument for pteridines screening
2. Three solution kits for the screening process
3. One quick method for giving an “yes” or “no” answer based on detectable oncopterin.
Current Status

• We are collaborating with Dr. Anthony Kaczmarek (Urologist) to conduct further research to find fingerprints for each cancer.
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