



# Exhaled Gas Analysis by GC-MS, Sampled from Flexible Bronchoscopy, for Finding Lung Cancer Biomarker



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## Background

The probability of lung cancer is increased and the survival is distinct between early and late stage of lung cancer. In this study, we analyze the exhaled gas, collected by bronchoscopy, to find lung cancer biomarker by using thermal desorption of gas chromatograph time of flight mass spectrometer (TD-GC-MS, Markers, Agilent 7890B).

→ Total 68 VOCs detected  
20 VOCs showed zero values in G1 sample  
2 VOCs were Lidocaine and its derivative (2,6-Xylidieni)  
Total 36 VOCs analyzed for Logistic Regression and PCA

→ Principle component analysis (PCA)  
G0 vs. G1 vs. G2  
G0 vs. G1&G2

→ Comparison between lung cancer stage and pathologic type (Logistic regression)

## Methods

- Prospectively enrolled data (n=20) for suspected or confirmed lung cancer patients between August, 2019 and October, 2019, were analyzed for GC-MS
- Three gas samples for each patient
  - Room air sample (G0)
  - Cancer affected bronchus gas sampled by bronchoscopy (G1)
  - Contralateral bronchus gas sampled by bronchoscopy (G2)

Suspected or Confirmed Lung Cancer

Enrollment (n=20)

**Exclusion**

- Metastatic RCC (n=1)
- Lung cancer not confirmed pathologically (n=3)
- Lab error (n=1)

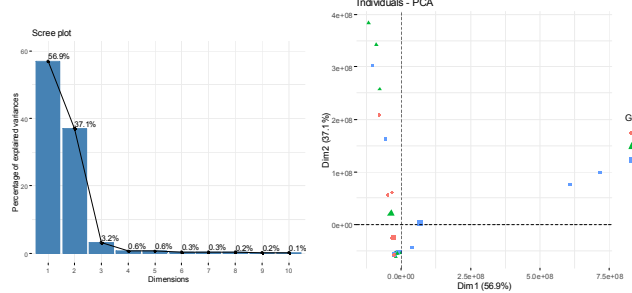
**GC-MS (n=15)**

G0 (room air)  
G1 (Cancer affected bronchus)  
G2 (Non-cancer affected bronchus)



Total 45 GC-MS data

1. PCA for Kruskal-Wallis rank sum test (G0 vs. G1 vs. G2)
  - PC 1 of p-value = 0.060
  - PC 2 of p-value = 0.39



### 2. OR between each gas sample

	OR	lb.95%	ub.95%	Pr(> Z )
2.6.Dimethylphenyl.isocyanate:1	0.999917	0.9997181	1.000116	0.4134
2.6.Dimethylphenyl.isocyanate:2	0.9999601	0.9998826	1.000038	0.3129
Dibutyl.phthalate:1	1.0000009	0.9999911	1.000011	0.8627
Dibutyl.phthalate:2	1.0000033	0.9999959	1.000011	0.3854
Ethanol:1	0.999981	0.999853	1.000109	0.7708
Ethanol:2	1.0000394	0.9999624	1.000116	0.3159
Diazeneboximidoyl.chloride:1	0.9997987	0.9995417	1.000056	0.1247
Diazeneboximidoyl.chloride:2	0.9999658	0.9997981	1.000133	0.6893
Acetone:1	<b>0.9996888</b>	<b>0.999374</b>	<b>1.000004</b>	<b>0.0528</b>
Acetone:2	1.000007	0.9999626	1.000051	0.7575
1.4.Pentadiene:1	0.9950464	0.4848757	2.042002	NA
1.4.Pentadiene:2	1.0000004	0.9999216	1.000079	0.993

- OR explained by each variable increased power by 1000
- 1 : G1 compared with G0
- 2 : G1 compared with G2

### 3. OR between lung cancer stage (III IV vs. II I)

	OR*	lb.95%	ub.95%	Pr(> Z )
2.6.Dimethylphenyl.isocyanate	1.0000194	0.9999967	1.0000975	0.54471648
Dibutyl.phthalate	0.9999929	0.9999826	1.0000003	0.11035486
Ethanol	0.9999158	0.999818	0.9999877	0.04663192
Diazeneboximidoyl.chloride	1.0001213	0.9999562	1.0003145	0.17548158
Acetone	1.0000262	0.9999883	1.0000815	0.23593363
1.4.Pentadiene	<b>0.9999645</b>	<b>0.9998265</b>	<b>1.0000529</b>	<b>0.50825866</b>

### 4. OR between lung cancer pathology (Adenocarcinoma vs. SCC)

	OR	lb.95%	ub.95%	Pr(> Z )
2.6.Dimethylphenyl.isocyanate	0.9999965	NA	1.000003	0.5953596
Dibutyl.phthalate	0.9999967	0.99998373	1.000004	0.4770154
Ethanol	1.0000043	0.99993425	1.000075	0.9022579
Diazeneboximidoyl.chloride	1.0000109	0.99983619	1.000181	0.8973296
1.4.Pentadiene	1.0000003	0.9999301	1.000065	0.9270085

## Results

Case	Pathology	Stage	G1 Wedging Bronchus	Age - 64.33 ± 11.4 (mean ± SD)	Gender - Male (n=10), Female (n=5)
1	NSCLC (Adenocarcinoma)	I	RB4		
2	NSCLC (Adenocarcinoma)	IV	LB1		
3	NSCLC (Squamous carcinoma)	I	LB2		
4	NSCLC (Adenocarcinoma)	I	RB9		
5	NSCLC (Adenocarcinoma)	IV	RB5		
6	NSCLC (Adenocarcinoma)	IV	RB10		
7	NSCLC (Squamous carcinoma)	IV	RB10		
8	NSCLC (Adenocarcinoma)	IV	LB8		
9	NSCLC (Adenocarcinoma)	I	RB6		
10	NSCLC (Adenocarcinoma)	I	RB1		
11	NSCLC (Squamous carcinoma)	II	RB8		
12	NSCLC (Adenocarcinoma)	III	RB1		
13	NSCLC (Adenocarcinoma)	I	RB1		
14	NSCLC (Adenocarcinoma)	I	LB1		
15	NSCLC (Adenocarcinoma)	III	LB1		

↓ Kruskal-Wallis test (p<0.05)

VOCs	sample=0		sample=1		sample=2		p value
	mean	sd	mean	sd	mean	sd	
Ethanol	24449433	8624426.8	37480065	16385581.26	30334060	13312539.78	0.0358493
Acetone	3411759.3	3220454.8	24712840	51767744.31	15949892.76	17918650.65	0.0019537
Octane..4.methyl.	2374773.3	3243220.2	9395622.5	8976941.956	7946938.381	6589787.465	0.0182294
2,6Dimethylphenyl isocyanate	1085646.7	4204691.5	5887283.1	7410028.687	102072259.9	244396013.9	0.0197282
1.4.Pentadiene	0	0	9187131.5	17544470.45	6046093.619	11173396.16	0.0453596

## Conclusion

There was a tendency that acetone (P = 0.0528) was a lung cancer biomarker in exhaled gas analysis.

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